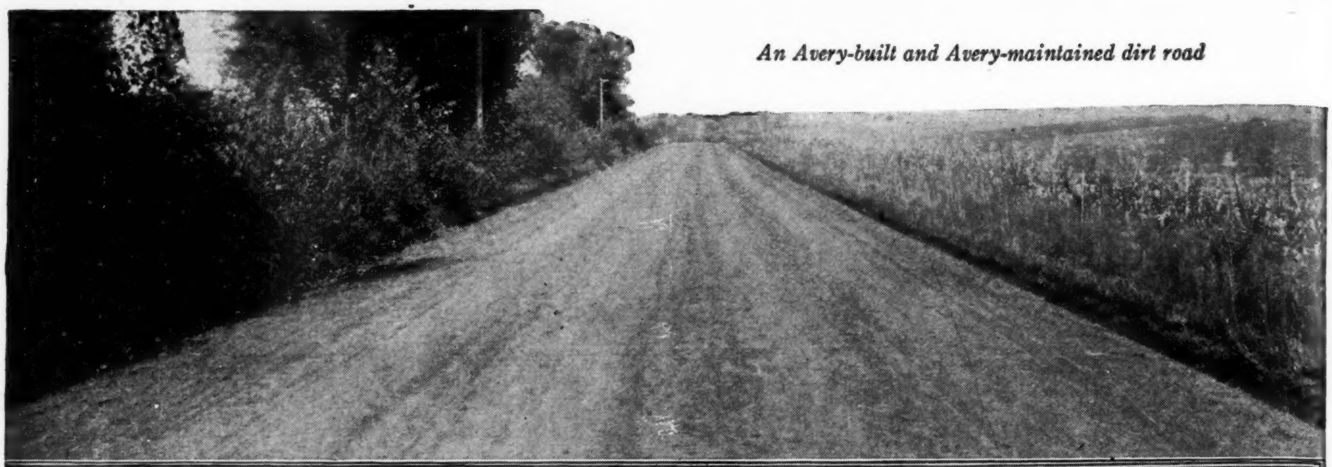
PUBLIC WORKS

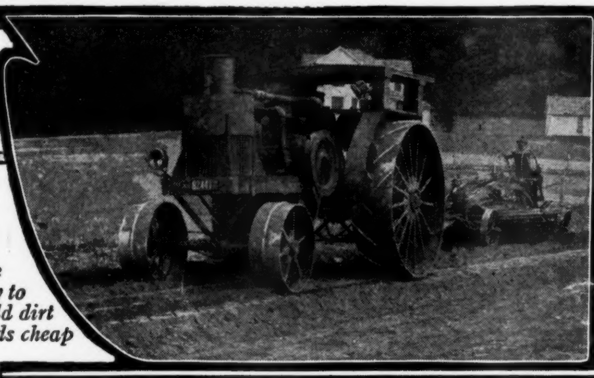
CITY COUNTY STATE

JANUARY 14, 1922



An Avery-built and Avery-maintained dirt road

Build Good Roads and Keep Them Good



The way to build dirt roads cheap

The way to maintain dirt roads good

Build Them Good With an Avery Road Tractor Keep Them Good With an Avery "Road-Razer"

TO have good roads through the spring "thaws", two things are necessary. *First*, build your roads *good* NOW with properly made crowns and ditches; second, *keep* them *good* by putting a "roof" on them by means of frequent maintenance.

To build *your* roads *good* there's a size Avery Special Road Tractor for every size job. They are the CHAMPION ROAD-BUILDERS OF THEM ALL. They have correct design and are strongly built—their weight is properly distributed so there's no "rearing up." Have a short turning radius so important in road building—and have maximum power. All their working parts are quickly and easily renewed—they also have many exclusive features, including the Avery "Draft-Horse" Motor and "Direct-Drive" Transmission. These are the reasons why Avery Road Tractors SATISFY—why they almost never wear out—why so many communities are using "fleets" of 3 to 16 Averys.

Then to *keep* your roads *good*, you want an Avery "ROAD-RAZER" the new one-man maintainer that shaves the roughest, ruttiest roads in a few minutes' time. Maintains dirt and gravel and crushed stone roads faster, cheaper and better than any other machine or method. Shaves off the bumps and ridges. Fills the chuck-holes and ruts. Is a self-contained unit—one man operates both machine and blades. Turns around in 3 seconds in its own tracks. Has wide, flexible, three-section blade that fits or makes any curve or crown of the road. Is sold on approval subject to demonstration and strongly guaranteed. Write for prices and further information.

Ask for special copy of the *AVERY GOOD ROADS NEWS*—the most important good roads booklet ever published. Every tax-payer and public official should have one. Sent FREE upon request. Address

Read What These Owners Say

The extracts below are from a few of the hundreds of letters from owners of Avery Special Road Tractors and Road-Razers

Upkeep Less Than $25.00 a Year

We have used an Avery 18-36 Road-Tractor for four years. We are entirely satisfied with it. It does the work 50% cheaper than horses and much better. Our upkeep on this machine has been less than $25.00 per year.
J. W. Woods, Clerk Olive Township, Olive, Okla.

Has Two Averys—Both Give Excellent Satisfaction

We have two Avery 14-28 Road Tractors. They have covered 4883 miles and $24.00 will cover the entire expense. Wm. Jeffries, State Highway Patrolman, Cooper, Nebraska

Especially Pleased With Performance of Avery Tractors

We have two Avery 25-50 Road Tractors. We built 102 miles of finished roads in 102 working days with them. The roads only cost us $35.64 a mile. Our total repair expense to date has been 25 cents for two glass oil bottles.
Phil Lagree, Road Foreman, Newton, Kansas.

His Third Tractor Will Be An Avery

I purchased my second Avery Road Tractor last Winter. It was an 18-36 H. P. I have not been out one cent for a part broken yet. I certainly recommend the Avery tractors for anyone wanting to do road work. My third tractor will be an Avery, because they are simple, strong, easy to repair and keep repaired. Roy Kellum, Petersburg, Ind.

Dirt Road Problem Saved

We are of the opinion that the maintenance of dirt and gravel roads at a minimum cost has now been solved by the Avery One-Man Road-Razer.
J. P. Harbour, County Commissioner, Pueblo, Colo.

Does More Work Than With Six Teams

I can do more work with the Avery Road-Razer than can be done with six teams of horses on small graders. I am highly pleased with this machine and we have now bought our second one.
Thos. Hardimon, Street Commissioner, Sioux Falls, S. D.

Have Six Avery Road-Razers

I find the Avery Road-Razer the best I have ever used or seen used. We have six of them at work now and are well satisfied with them.
J. P. Nicholson, General Supervisor State Highway Department, Washington County, Okla.

AVERY CO., 225 Iowa St., Peoria, Ill.

AVERY

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PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 NEW YORK, JANUARY 14, 1922 No. 2

New London Turnpike

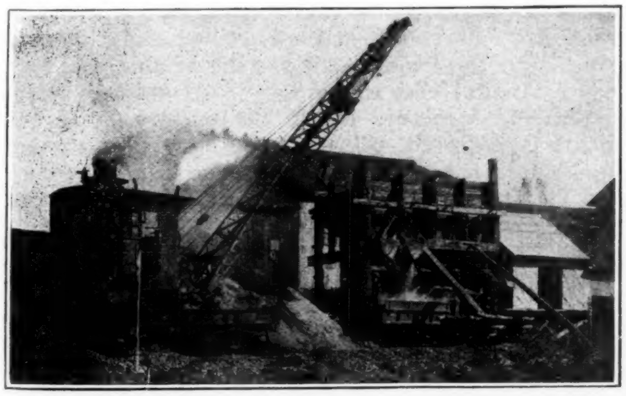
Building thirty-two miles of 18-foot concrete highway in one season with 700 men and four paving machines. Aggregate purchased, produced by contractor, shipped by rail and truck, stored at central and at intermediate points, handled at storage by three locomotive cranes at a cost of only 9.22 cents per ton and distributed by industrial track and trucks.

The Highway Commission of the State of Connecticut awarded to C. W. Blakeslee & Sons, New Haven, at unit prices, the contract for the construction of the 33½ miles of the state highway known as the New London Turnpike, and extending from Glastonbury, about eight miles south of Hartford, through Marlborough, Colchester and Chesterfield to a point about four miles north of New London.

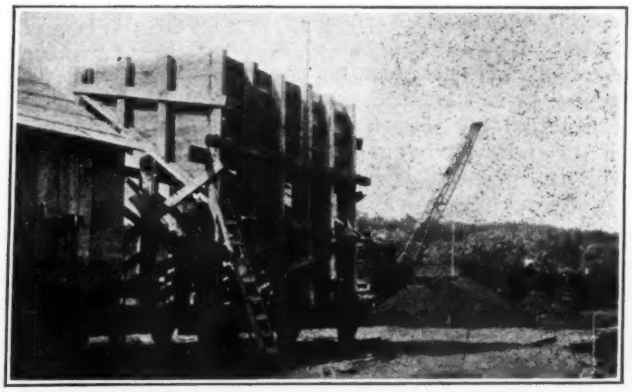
The road, which is within 150 miles of New York, follows the alignment of an old earth road with very little improvement or hard surface that wound around the contours of a hilly and very sparsely settled agricultural district and served only for limited local access to and from the nearest improved roads. It had many grades, some of them excessive, and numerous sharp turns, both of which were considerably reduced in the new line, which has a maximum grade of 11 per cent. and in the first few miles north of Glastonbury surmounts a hill 600 or 700 feet high involving heavy cuts and high embankments, some of them of as much as 20 feet.

The road was built with Federal aid and the hearty co-operation of the Federal and chief engineers in testing and examining all materials used in its construction and in the determination of grade and the design of foundation and subgrade insured unusual excellence of design and construction, the latter being effected by a large organization supplied with abundance of high-class equipment and directed by superintendents of proven ability and experience.

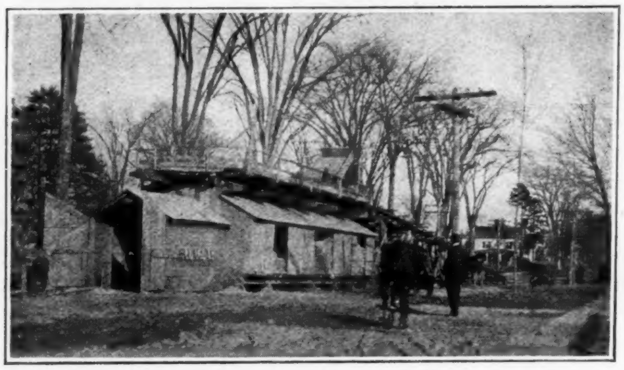
The road has a concrete surface 18 feet wide, 8½ inches thick in the center and 6 inches thick at the edges, without reinforcement and with expansion joints 35 feet apart. On each side is a shoulder 5 feet wide. There are eight beam and slab bridges of 9 to 25 feet span and many pipe culverts with concrete end walls. The local drainage is cared



CRANE AT COLCHESTER YARD LOADING DIRECTLY INTO A TRUCK



STONE BIN OF THIRTY-FIVE YARDS CAPACITY AT WESTCHESTER



COLCHESTER 60-YARD SAND AND STONE BIN AND INCLINED TRESTLE APPROACH

for in longitudinal rubble pipe drains adjacent to the shoulders, connected when necessary by transverse pipe drains underneath the roadway.

The principal quantities involved include about 111,530 yards of earth excavation, 21,000 yards of rock excavation, and 36,000 yards of borrow pit excavatioin for embankment. The pavements, bridges and culverts required about 67,000 yards of concrete for which it was necessary to provide 60,000 yards of stone and 30,000 yards of sand; the cement, amounting to about 375,000 bags, was provided by the state.

As there was very little traffic over the original road, no difficulty was experienced in diverting it in nearly all cases, so that the new construction was carried on practically regardless of traffic, except in two places where short sections of the road were necessarily left over until next season and will be constructed in successive longitudinal halves to maintain the traffic between the adjacent long sections of finished roadway already in service. Construction was commenced in April, 1921, and on November 15, when the concreting was suspended 32 miles of the pavement had been completed, leaving only two short strips of about ¾ mile each to be concreted next spring to finish the job. After the cessation of the concreting, work was continued until late in the season, chiefly consisting in completing the shoulders, finishing a small portion of difficult grade and in temporarily surfacing the subgrade of the incompleted mile and a half of road with quarry dust to enable it to bear the winter traffic and allow the road to be in service. It is possible that, considering the unusually warm November weather, the concreting might have been completed this season if the contractor had insisted on it, and had been willing to assume the added difficulty and expense of concreting in cold weather, provided such work had met the approval of the engineer; but it was deemed by all to be more satisfactory to stop the concrete practically at the beginning of frosty weather, leaving a small portion to be done early next season.

EXCAVATION

Excavation was carried on simultaneously at several different points by four Marion revolving and Erie steam shovels and one gasoline operated Pawling & Harnischfeger excavating machine, equipped with a ½-yard clamshell bucket. The rock was drilled by means of 16 Ingersoll-Rand tripod and 6 jack hammer drills operated by 4 portable boilers and by three portable Imperial type air compressors.

The excavated material varied from sand to loam and cobbly gravel and rock. For the rock excavation there were 7 drilling outfits all equipped with Ingersoll-Rand apparatus. Three of them used air compressors, each requiring one operator and supplying one or two jackhammer drills. The other four outfits each had a 5 h. p. locomotive boiler and four tripod drills, which were operated on thorough cuts. The deepest rock cut was about 20 feet. In one place the new alignment involved heavy rock cutting for the excavation of about 300 yards of irregular seamy-granite that was difficult to handle because the drills would frequently strike a crack or seam in which they were lost, necessitating the starting of a new hole.

The explosives used were chiefly 40 to 60 per cent. regular gelatine nitroglycerine in one pound sticks fired by a battery. Some TNT purchased from the War Department was used in drill holes, but it was found to work more satisfactorily on mud caps. The dynamite was stored in three dugout magazines, which were replenished about once in two months.

None of the rock excavated was suitable for concrete work and all of it was spoiled for use in embankment. The steam shovels were served with about forty 5-ton trucks mostly of the Mack and Pierce Arrow types, and by about seventy-five 2-horse bottom dump wagons.

In the earth cuts the steam shovels were followed by wheeled scrapers, of which about twenty were provided. The smaller ones were drawn by horses, but the larger ones, of the Champion type with 10-foot blades were hauled by a Cletrac tractor, finishing the subgrade advantageously about 400 feet minimum, in advance of the concrete mixer.

An attempt was made to use a sub-grading machine, operated on the steel side forms, but this was not satisfactory on account of large quantity cobble stones it encountered that caused the machine to jump and operate irregularly.

Where the new road was built over previous roads that had stone or macadam surfaces, the latter were thoroughly loosened with a scarifier attached to a steam roller. All of the subgrade was thoroughly rolled to acurate cross section and elevation determined by a level and straight edge with which it was carefully checked. If the grade was found low, more material was added and rolled to bring it to the exact position, the engineers being very particular that the subgrade should be perfect so that the concrete would be uniformly of the thickness required. There were installed five ten-ton Buffalo rollers, each with a scarifier, and operated from 400 to 600 feet in advance of the mixer.

Wherever the subgrade was wet, and in swampy places, the excavation was made 15 inches below regular subgrade elevation and there was built a foundation of Telford stones 12 inches thick covered with 2 inches of crushed rock and a layer of sand thoroughly rolled to subgrade.

All of the Telford excavations and some of the ditches for rubble drains and excavations for culverts, were made with steam shovels, but where these were not available the work was done by hand. The rubble drains, 36 inches below grade, consisted of a bed of ¾-inch crushed stone on which

were laid 6-inch tile pipes with open joints covered with larger stones laid carefully up to within 6 inches of the subgrade, and then covered with brush or straw mattress and crushed stone. There were in all about 30,000 square yards of Telford, 20,000 lin. feet of rubble drain and 6,600 lin. feet of cross culverts. The culverts were made with pipe up to 30 inches in diameter. The ends of all culverts were enclosed in concrcete or masonry headwalls, for which and for the bridges there was used a portable 2-bag Chain Belt mixer.

The 33½ miles of road were divided into four equidistant contracts, No. 1 extending from Glastonbury, where there was a freight station, about 8 miles south of Hartford, to Marlborough. The second section extended from Marlborough, passed through Westchester where another freight station was established, and extended south to Colchester, where there was established a freight yard. Section 3 extended from Colchester, south to Salem. Section 4 extended from Salem to a point four miles from New London, with a freight station established near that end of the section.

All of the aggregate for the first four miles at the north end of the road, in contract one, was delivered by trolley cars to the freight station at Glastonbury, where there was a cement storage shed of 12 yards capacity, supplied by railroad cars running over the trolley line from Hartford.

The contractor established four railroad freight yards for the receipt, storage and transfer of supplies and equipment, all of which received broken stone, cement, coal and machinery and were served by two Brownhoist 15-ton locomotive cranes, one Browning Hoist crane, and one Pawling & Harnischfeger locomotive gasoline crane.

At the Westchester yards the broken stone was received in railroad cars and unloaded into stockpiles by the locomotive crane, which also towed the loading hopper alongside the stockpiles. At Glastonbury the stone was delivered in automobile trucks that were run up a ramp built on a timber trestle and carried over the loading hoppers into which they dumped directly. At Glastonbury the broken stone was received in side-dump standard gage cars, run over the trolley line and up an inclined trestle to a height of about 20 feet above the ground, where they were dumped to make a large storage pile in which 1,200 to 1,500 yards of stone were accumulated before operations were commenced; but the stone was shifted from the storage pile to the 8-yard loading hoppers by a locomotive crane that was kept constantly busy although not operated to its full capacity. At both the Westchester and Glastonbury yards the locomotive cranes were more than competent to handle all the stone to and from the storage piles and loading hoppers, and to handle the coal and perform other services such as shifting cars, unloading plants and serving as general locomotive derricks.

The first locomotive crane was installed at the commencement of operations in April, 1920, another was installed in May, and a third in July, 1921, after which one was removed to another job, leaving two Brownhoists and one steam crane on the road construction. For this work the Brownhoists were equipped with ¾-yard and 1-yard buckets and unloaded a 45-ton car in an average of about one hour, thus having a capacity for eight cars per day. In practice this number was reduced to about five cars per day because that number sufficed for the amount of construction in progress and because the switching facilities were limited and considerable time was lost by the Brownhoist in handling the full and empty cars. As about one-third of the broken stone was first unloaded into storage piles and afterwards transferred, reclaimed and placed in the loading hoppers, the average duty of 225 tons a day for each of the Brownhoists was really equivalent to 300 tons per 8-hour day, which was considered very satisfactory. The contractor estimates that the life of the locomotive cranes is at lease fifteen years and perhaps twenty years.

During the working season of 192 working days between April 15 and December 1, each locomotive crane consumed about ⅝ ton of coal per day, making a total of 120 tons at $9.00 per ton. The operation of the crane required one engine man at $9.00 a day and one fireman at $4.00 a day, making the total labor cost for the year $2,496. The interest on the investment at 7 per cent is $353.27, depreciation on the cost price of $9,460 divided by 16 years is $630.07, repairs and maintenance, including cables, $750, making the total operating cost for one year $5,309.84.

The service performed by the crane, namely unloading five cars per day for 192 days is 950 cars or 42,200 tons, plus 20,400 tons handled from storage to bin, equals 57,600 tons at a cost of $0.0922 per ton.

It is estimated that the cost of the same work done by hand would be $.50 per ton or $28,800, thus showing a saving of $23,490.16 made by each locomotive crane, equal to $46,980.32 for the two Brownhoists applied continually on the road work or a saving of 40.78 cents per ton on the material handled.

CONCRETING CULVERT WITH PORTABLE MIXER

DIFFICULT ROCK EXCAVATION IN DARK HOLLOW

CLETRACTOR HAULING ROAD MACHINE OVER MACADAM ROAD

Up-to-date Concrete Road Construction

Brief reports from recent work in different states.

Contractors for concrete road construction throughout the United States have, during the past few weeks, sent to PUBLIC WORKS various data regarding the magnitude and character of the work they were engaged on, the requirements, conditions, diffculties encountered, equipment installed, methods of construction, and efficiency and rapidity attained. Some of these data, indicating special features or unusual results, will be presented in separate descriptive articles; others that may not present any unusually important or novel features but are nevertheless valuable as representative of current practice or standard operations have been selected as describing satisfactory results and reliable efficiency. Some of them are here summarized.

SAXONBURG ROAD

This road is located in West Deer township, Allegheny county, Pennsylvania, and is 7,400 feet long with 600 feet of a maximum grade of 7.25 percent and 390 feet of curve with 350 foot maximum radius.

The road is a new location through rolling country in a loam soil, and involves 27,750 cubic yards of excavation without rock work, culverts or bridges. The contract was awarded to the McCrady Bros. Co., Braddock, Pa. Work was awarded August 26, 1921, and it is expected will be completed on June 15, 1922. The total contract price is $37,258.50 or $5.04 per linear foot of paving. The average force consists of 50 men working 10 hours per day and receiving thirty cents per hour for laborers and one dollar per hour for mechanics.

Broken stone and sand are delivered by rail to a central storage plant, where it is handled by Galion loaders, stored in bins and delivered in measuring boxes, hauled by five motor trucks. The concrete is surfaced with a Lakewood finisher, and protected during curing by tarpaulins, straw and moistened earth. The best daily record is 480 linear feet.

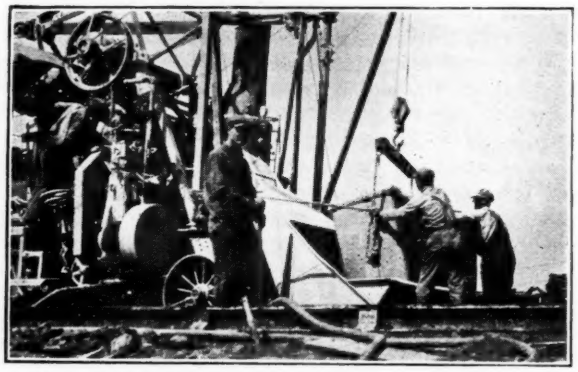
LINCOLN HIGHWAY

Federal Aid Project No. 18 in Clinton County, Iowa, is a 17.5 mile stretch of the Lincoln Highway paved with reinforced concrete 18 feet wide, 8 inches thick at the center and 7 inches thick at the sides, under the direction of P. W. Shive, resident engineer. The location is an old alignment with 6 percent maximum grade and two right angle curves. There is about 80,000 yards of dry earth excavation in level and hilly country and with a maximum haul of 7,000 feet, made with elevated graders, wheelers, slips and Fresno scrapers.

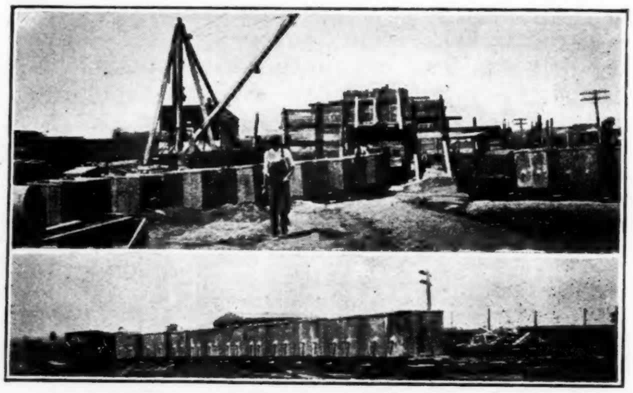
Aggregate was received on railroad cars and unloaded to stock piles with a derrick and clam shell. It is handled to the concrete paver by two separate outfits, one consisting of automobile trucks loaded from a hopper bin that served eight miles of the road and the other an industrial railway outfit that served the remaining 9½ miles. Each of the two sections in which the work was executed was equiped with a 21-E Koehring mixer operated by a steam engine. The greatest amount of pavement laid in one 8-hour shift was 650 linear feet. The contract was awarded May 1st and completed October 1st and was considered by the contractor, the Koss Construction Co., Des Moines, Iowa, to be extraordinary only in the fact that it was the largest single stretch of concrete contract awarded up to date.

On the section operated by the industrial track service the Koppel tracks ran alongside the cement storage shed and were connected to the loading track on both ends of the storage pile through which the track passed in a wooden tunnel with vertical transverse wooden bulkheads at both ends to retain the aggregate that was unloaded from the railroad cars and piled over the tunnel by a derrick and clamshell bucket. The Koppel batch boxes were loaded in pairs on flat cars, from 7 to 11 of which were drawn in trains hauled by Plymouth gasoline locomotives, which passed entirely through the tunnel and could be switched from the main track.

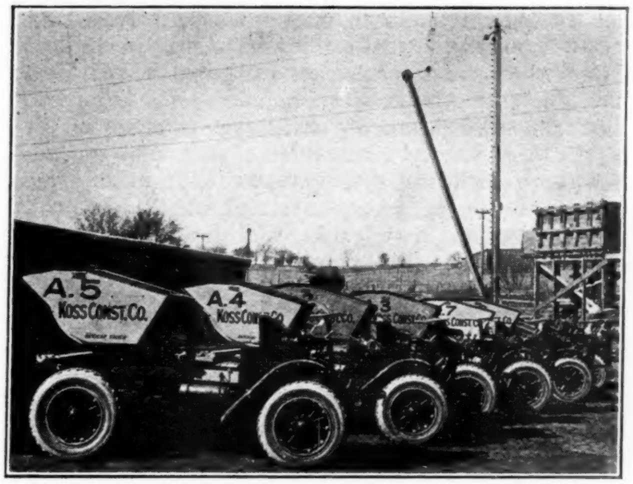
On the other section of the road tilting hoppers carried in pairs on a fleet of auto-car trucks delivered directly to the loading skips of the paver, against which the truck backed up until it engaged a buffer, dumped the bucket, advanced while the mixer was being charged and when the skip was returned to position on the ground backed up again and discharged the second of the pair of buckets it carried.



DUMPING BATCH BOX INTO PAVER SKIP



UNLOADING DERRICK SERVING STOCK PILE OVER LOADING TUNNEL—GASOLENE LOCOMOTIVE HAULING TRAIN OF INDUSTRIAL CARS WITH PAIRS OF BATCH BOXES



FLEET OF TRUCKS HAULING AGGREGATE TO PAVER, LINCOLN HIGHWAY

OHIO HIGHWAYS

The Republic Asphalt Paving Co., Dayton, Ohio, was the contractor for 3 miles of 16-foot concrete pavement 8 inches thick in Auglaise county, Ohio. The work was executed in six weeks, materials being hauled to the Koehring paver in trucks, each of which carried four batches and dumped directly into the skip of the machine.

In Shelby county, adjacent to Auglaise county, the same contractor built one mile of 16-foot, 8-inch concrete pavement in 12 days using the same method. The same paving machine was also used by the contractor with satisfactory results in Wilmington, Ohio, and was considered to be preferable for this work to the number 11 Koehring machine that required nearly as much fuel and oil but had only about half the capacity. The best record for one 10-hour shift was 712 linear feet of 16-foot roadway 8 inches thick, paved with 1:1½:3 concrete.

IN CHAMPAIGN COUNTY, ILL.

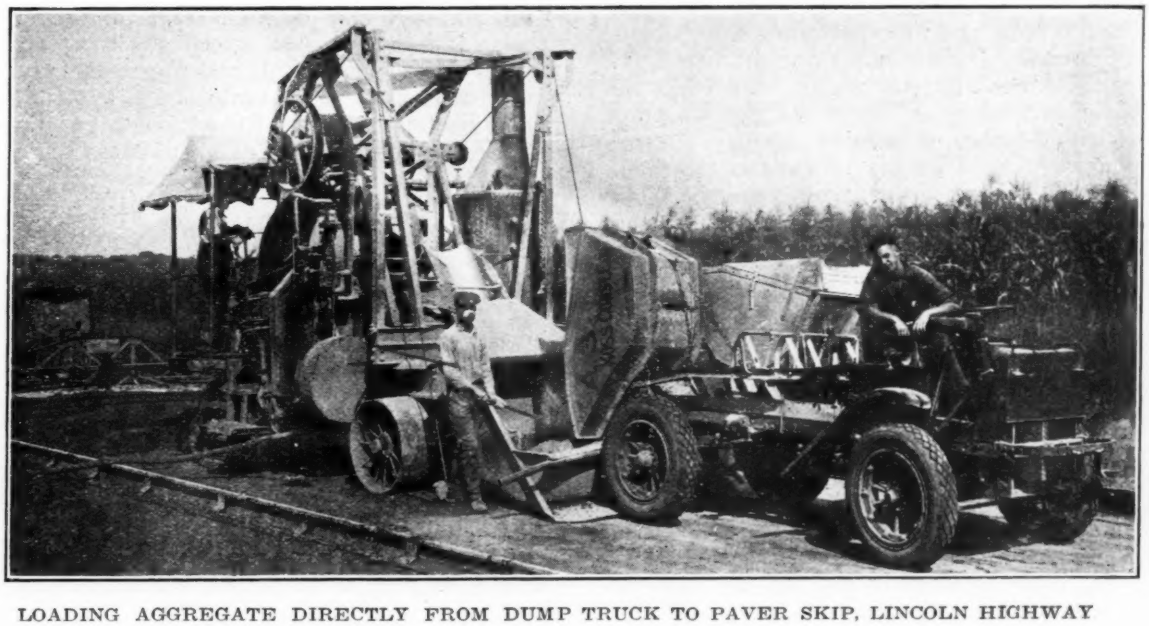
The contract for the 12½ miles of 18-foot concrete highway, 7-inches thick in Champaign County was awarded for $270,000, to the Barns & Verhey Construction Co., St. Joseph, Ill., who commenced operations March 9th, 1921, and expect to complete them by July 1, 1922. The work consists of the improvement of an old road, with grades reduced to one per cent, requiring 40,000 yards of excavation with a maximum haul of 500 feet.

The aggregate was unloaded by a crane, that placed it in stock piles and delivered to automobile trucks by which it was taken to the 21-E mixer that advanced at a maximum rate of 660 linear feet in eight hours with a total force of about 30 men inclusive of those employed in grading, which was done by the sub-contractor. Water was delivered to the job by the contractor with C. H. & E. pumps, and the fresh concrete was protected by canvas until after initial set.

LACKAWANNA TRAIL

The contract for 6½ miles of concrete highway pavement on the Lackawanna Trail between Nickelson and Forster, Pennsylvania in the State Highway System was awarded for $420,000 to the Awixa Corp., Islip, N. Y., which commenced operations June 16, 1921 and expect to complete the work within one year from that date. The road, 20-feet wide and from 6 to 8 inches in thickness, is constructed on a new alignment in hilly country with maximum grade with 3½ percent and curves of 6 degrees. It involves the excavation of about 25,000 yards of earth and 25,000 yards of rock, a maximum haul of about ½ mile. The total amount of concrete required is about 35,000 yards, besides 1,500 yards of culverts. Aggregate is received by rail and unloaded by a crane and immediately delivered to the mixer without intermediate storage. It is taken in automobile trucks to the 21-A Koehring paving machine and to the Koehring Dandy Mixer for culvert work. The maximum progress has been so far 1,096 square yards in eight hours and the total force of 135 men with a weekly payroll of about $4,000.

Grading was done with Bucyrus steam shovels, served with four 4-yard trucks and water was pumped by the contractor's C. H. & E. pumps delivering through a maximum of 4 miles of pipe.



LOADING AGGREGATE DIRECTLY FROM DUMP TRUCK TO PAVER SKIP, LINCOLN HIGHWAY

A FEDERAL AID MISSOURI ROAD

Federal Aid Project 79 in St. Louis County, Mo., consists in the construction of 12.7 miles of concrete highway pavement with a maximum grade of 8 per cent. and 5 degree curvature. The alignment is through a hilly country with 85,000 yards of earth excavation involving a maximum average haul of 600 feet. Operations were commenced May 30 and completed October 26, 1921. Aggregate was received in railroad cars, unloaded with clamshell buckets and delivered from storage to batch boxes, hauled to the 21-E Koehring machine, which made a maximum amount advance of 1,856 square yards in eight hours. Water was delivered to the work through C. H. & E. pumps, discharging through a maximum of 28,000 feet of 2-inch pipe, and the concrete was cured by pondage and wet earth covering. The average force employed was 40 men and a payroll of about $3,000 per week.

PORT COLDEN-BROADWAY ROAD

Route 12, Section 5 of the State Highway Department, New Jersey, is a double reinforced concrete road 20 feet wide, 8 inches thick, and 3.7 miles long that is under construction by the Hudson Contracting Corporation of Jersey City for a contract price of about $225,000. It traverses a hilly country following the old location and having maximum grade of 6 per cent. and curve of 6 degrees. There are about 12,000 yards of earth excavation made with a Keystone No. 4 grader and 6-ton automobile trucks hauling spoil a maximum distance of 2½ miles. The average fill is about one foot in depth and there are six culverts. The total amount of concrete required is approximately 55,000 square yards.

Aggregate is received in railroad cars, unloaded by a locomotive crane and clamshell bucket, stored in bins and chuted from them into batch boxes, delivered to a No. 14—E Rex paving mixer timed for 1½-minute batches. The total force consisted of about 35 men and the average progress has been 300 linear feet per day. The greatest amount laid in one day of eight hours has been 792 square yards. The total weekly payroll was about $3,100 and the average number of men employed, 110. Water for the mixing, curing and other purposes was pumped by the contractor from creeks along the line. The fresh concrete was protected with canvas covers until after it had taken an initial set and was then covered with 3 inches of straw or salt hay kept wet for 14 days. The work was commenced September 22nd, will be suspended during December, January and February, and it is expected will be completed about May 1, 1922. It is being executed under the supervision of Fred L. Hartigan, general manager for the contractor, and M. M. McDougall, engineer for the State Highway Department.

AN INDIANA HIGHWAY

The Dogwood Project is a 16-foot concrete road 5 miles long with a maximum grade of 2.7 per cent., which required about 75,000 yards of black soil and clay excavation which in deep cuts was made with steam shovels, while light cuts were made with wheel scrapers and slip scrapers, the spoil being hauled a maximum distance of about 2,000 feet.

The aggregate received in railroad cars was unloaded with a clamshell bucket which delivered directly to small elevated loading bins or to stock piles, from which the same bucket reclaimed it and filled the bins as the latter were emptied. The sand and stone bins were separate structures commanded by a stiff leg derrick with 40-foot mast and 60-foot boom. Cement was delivered by cars from the same sidings as the aggregate cars and was stored in a 16x80-foot shed with loading platform alongside the industrial track that passed under the aggregate bins.

Western batch boxes of 33 feet capacity were loaded in pairs on flat cars in three 10-car trains hauled by Plymouth gasoline locomotives to a maximum distance of 5.5 miles. One full and one empty train was constantly on the road, while the cars of a third train, spotted under the bins by a rope from the derrick engine drum, were being loaded to avoid loss of time at the storage piles. The aggregate was delivered to the batch boxes through gates in the overhead bins and the cement was dumped by hand to the loading platform after the proper quantity of aggregate was placed in the boxes. Two men unloading and three men distributing the cement and aggregate sufficed for handling the 40 cars and 80 batch boxes.

The concrete was mixed in a No. 21-E Koehring paver and was finished with a Lakewood machine. The total amount of concrete required was about 23,100 yards, besides 500 yards for the culverts. The contract price was $444,947 and the weekly payroll averaged about $1,000 for an ordinary force of 50 men. The greatest amount of concrete laid in eight hours was 292 cubic yards. The work was commenced August 30th and completed November 5, 1921, under the direction of Superintendent J. R. Morgan.

PAVING IN GRAND FORKS

The Northern Construction Co., Grand Forks, N. D., laid about 91,000 square yards of concrete pavement in the streets of Grand Forks under the city supervision of J. J. Bith, city engineer, between May 1st and October 24th, 1921, and inclusive of about 30 days rain. The pavement is from 30 to 34 feet in width and has an average thickness of 7 inches. It is laid in new streets involving an excavation of about 50,123 cubic yards of rather spongy earth that was handled by a Holt 10-ton tractor hauling a small Russell elevating grader machine that delivered to from 8 to 23 horse-drawn wagons hauling the spoil a maximum distance of about one mile.

The aggregate was received in open-top railroad cars and unloaded by a steam operated clamshell bucket that delivered to a stock pile or direct to a hopper over a screen, from which the stone was discharged into a small hopper where cement and sand were added and the aggregate delivered to the ¾-yard Lakewood mixer operated by an electric motor. From the mixer the concrete was hoisted in a tower, from which it was spouted to a hopper under which ten Pierce Arrow and three Nash Quad 2-ton trucks received their 1½-yard load in about ten seconds at a maximum rate of about 40 batches per hour. The concrete was hauled an average distance of ¾ mile over a good road to the mixer, where the dumping

into the skip occupied about 30 seconds. The best record was concreting 1,824 square yards of 7-inch pavement by eight trucks in 10 hours. The best record for one week was 10,000 square yards of 7-inch pavement. The cost per yard of hauling the concrete, including the rental of trucks, drivers' wages, mechanics' wages, repairs, gas and oil, was $.65, all of the mechanics being paid $12 per day.

The force employed included 22 men at the mixer, 7 to 10 men on the trucks hauling the concrete, 14 men dumping trucks, spreading and finishing concrete, 2 carpenters and 2 laborers setting the curb, an average of 40 men rough grading, finishing the subgrade, and covering the pavement with earth, which was kept sprinkled; 1 mechanic, 1 helper and 15 teams hauling dirt.

Pittsburg Test Highway

Observations made during December. Moisture content of subsoil. Changes in dimensions of slabs due to temperature. Center of road rises during the day and falls during the night. Expansion causes a series of transverse ridges, resulting in cracks.

By Charles W. Geiger

Water has been turned into the ditches that have been built on either side of the test highway at Pittsburg, California (see Public Works for October 29, and December 10) and it is now on a level with the top of the subgrade.

Through holes provided in the concrete pavement borings were taken of the subgrade while it was perfectly dry, and other borings are now being taken (and will continue to be taken) of the wet subgrade to determine the moisture content. From observations taken in the tunnels, the relationship between the moisture content of the subgrade and its bearing power under traffic conditions will be learned. Some interesting data on the bearing power of wet and dry subgrade will soon be available.

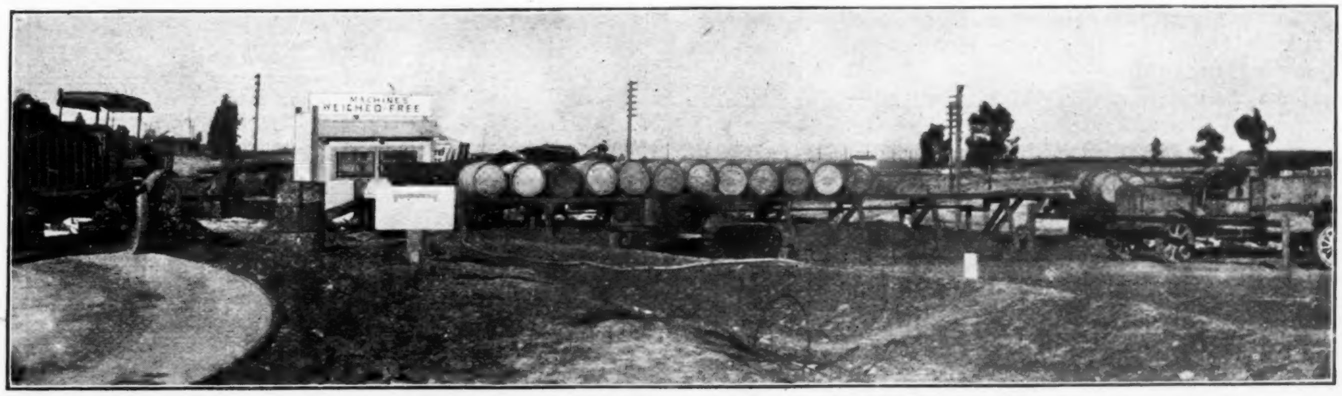
Drawings of each of the thirteen sections of the test highway with all cracks to date chartered thereon have been sent to road engineers and others interested throughout the state of California, and each week data regarding the further development of all cracks will be sent to those receiving the drawings, thereby keeping them posted regarding the conditions of the test road.

The loads carried by the trucks were increased a few days ago. At the present time seventeen trucks are operating over the test highway with a gross load of 24,500 lbs. and seven trucks with a gross load of 29,000 lbs.

While there were forty trucks at the disposal of the engineers for operation on the test highway, not all of them were kept on the track as it is often necessary to make repairs on trucks. Most of the time there were about 36 trucks in daily operation, until recently when this number was reduced to 24. From November 9th up to and including December 11th the trucks had made a total of 60,860 miles, consuming 12,646 gallons of gasoline and 1,725 quarts of oil.

Over 500 gallons of gasoline is used daily at the test highway and the supplying of this fuel is a problem in itself. The gasoline is brought to the test track in tank wagons and pumped into steel drums which are supported on special wooden racks. After the trucks have been stopped for the night, these drums are rolled onto a truck which drives alongside the trucks, supplying each with the proper amount. This requires about 6 hours each night. Two skilled mechanics are kept busy at all times in keeping the trucks in good running order.

Some time ago considerable rain fell at the test highway, and the track became covered with the adobe, which caused a number of the trucks to run off the track. In such cases a chain was attached to one of the trucks, which helped pull the derailed truck back onto the track. In a number of cases a caterpillar tractor was necessary for this purpose.



ROLLING DRUMS OF GASOLINE TO MOTOR TRUCK (SHOWN AT THE RIGHT), WHICH SUPPLIES GASOLINE TO TEST TRUCKS

SMALL SECTION OF SLAB IN SECTION B BROKE AWAY AND DROPPED BELOW LEVEL OF REST OF SECTION

Later a shoulder of brick was placed on both sides of the track for its entire length, and the mud washed off, since which time very little of this trouble has been encountered.

TEMPERATURE CHANGES IN DIMENSIONS

Ames dials (an instrument so constructed that movements as minute as 1-10,000 of an inch are detected) were fitted with a special iron jacket and used in measuring temperature changes throughout the entire width of a slab at two-foot intervals. and along both edges of the slab (which was 150 feet in length) at 6-foot intervals. Observations were carried on for a considerable period, the most important ones being obtained when the day was warm and the nights quite cool.

The results from these observations were a surprise to many of the engineers. At 1 P. M. one side of the slab was turned down .008 inch below the horizontal level of the slab and at the same hour the center of the slab was raised .01 inch above the horizontal level of the slab, thus producing greater stress on the slab, because it was resting on the subgrade at only two points of the cross-section.

At 12 midnight the condition is just the reverse, the edges being curled up .01 inch while the centers are on grade. This produces very severe conditions for the slab along the edges for early morning traffic. This condition is conducive to longitudinal cracks two or three feet from the edge.

These temperature observations were carried on over a period of 24 hours, observations being recorded every hour. It was found that the maximum vertical upward movement of the center of the slab occurred at 1 P. M. The maximum vertical upward movement of the edges occurred at 6 A. M. It was found that the slab was lying flat on the subgrade throughout its entire length at 5 P. M. and at 10 A. M.

From observations taken along the edges of slabs by means of Ames dials it was found that there existed a series of waves at the time of the highest temperature of the day, and that transverse cracks seemed to appear at the top of the waves. This phenomenon in an aggravated degree accounts for the explosions that occur on concrete pavements. This wave condition seems to point in the direction of the need of more expansion joints.

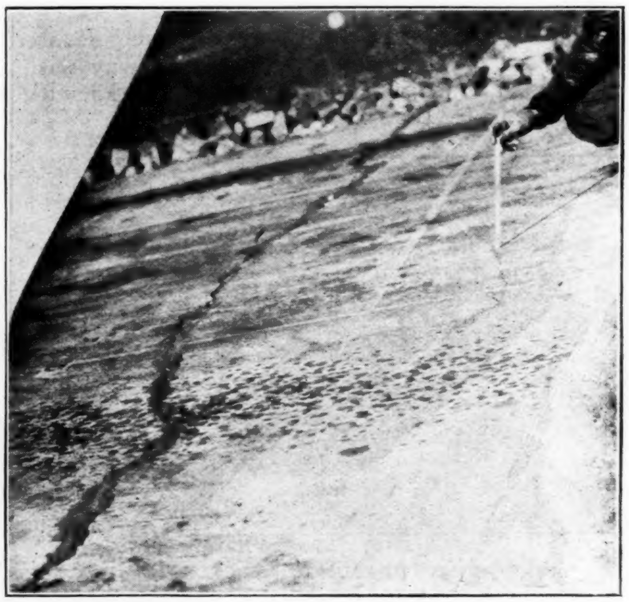
Temperatures of the top and bottom of the slabs were taken and it was found that there was a maximum difference of seven degrees between the temperature of the top of a slab and the bottom. When the temperature of the top and bottom of the slab was equal the slab lay flat on the subgrade. When the top was warmer than the bottom, the center of the slab was raised up off the subgrade.

OTHER TESTS

It was thought by the engineers that probably the surface of the test track had softened up because of the truck traffic, and in order to find out if this theory was true, they are using a hydraulic jack called a loadometer for the purpose of pressing steel balls of various sizes into the surface of the concrete. They are trying this out on concrete that has not been subjected to traffic and also on various parts of the test highway—on the middle of the slab where the truck wheels do not touch, on the edges where the truck wheels run, on sections that are broken, and on sections where cracks have appeared. This is said to be the first time that such a system has been used in such tests. In the photograph showing this test, A shows a steel ball placed under a steel plate B. Over this plate is placed the loadometer. The loadometer is placed under a heavily loaded truck, so that the top shown at C will engage one of the truck's axles, forcing the ball down into th concrete when the loadometer is operated.

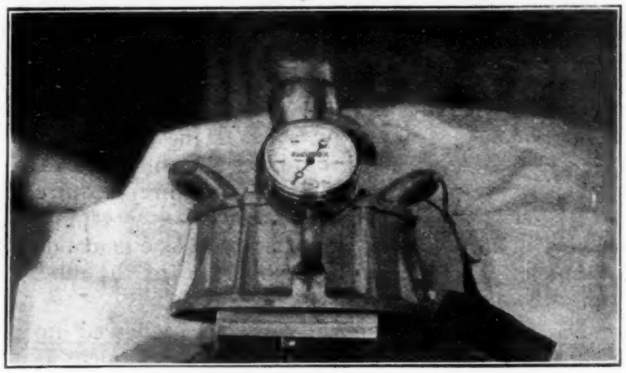
The first tests of static and speed impact with an automobile passenger vehicle were successfully completed by engineers in charge of the test track a short time ago when a Studebaker "special six" touring car, with two passengers, went over the testing tunnels. Speed tests were taken at 19½, 21 and 35 miles per hour and the impact of a one-inch and a two-inch drop were both taken at 35 miles per hour.

Because of the length of the oval track, which is a quarter of a mile in circumference, safety would not permit any greater speed than forty miles per hour. However, the table reproduced here, showing the depression of the road, demonstrates that the speed impact is reduced as speed is increased. The readings were taken from the fourth testing rod, approximately in the center of the road.



CRACKS IN SECTION A, DECEMBER 15

C



B A

USING LOADOMETER TO MAKE HARDNESS TEST ON CONCRETE SURFACE

Static	.0016 in.
19½ miles	.0013 in.
21½ miles per hour	.0013 in.
35 miles per hour	.001 in.

The one-inch and two-inch drop impact readings taken at 21½ miles per hour were:

1 in. drop	.003 in.
2 in. drop	.0037 in.

The car and its two passengers, before proceeding through the test, were carefully weighed and found to scale 3,620 pounds. This weight was carried during the test.

An eight-wheel motor bus weighing about 8,000 lbs. was run over the test highway recently, and comparisons made with a four-wheel motor truck of the same weight equipped with pneumatic tires, which also was run over the track. In impact tests, the eight wheel bus only caused 70 per cent as much deflection as the motor truck. In the moving test, the eight wheel bus caused about 10 per cent less deflection than the motor truck.

Tests of other vehicles will be made after the engineers have entirely satisfied themselves as to the results of the present operations.

Recently the Motor Truck section of the San Francisco Motor Car Dealers Association sent a committee to the test highway and a series of tests were made with trailers, semi-trailers and with a low-bed truck. Some interesting results concerning these tests will be announced soon.

In charge of the entire test is Lloyd Aldrich, consulting engineer of San Francisco, aided by John V. Leonard, also an engineer, and a corps of assistants.

Pennsylvania State Highway Testing Laboratory

Makes material surveys, tests and researches and controls quality of construction materials in field and at mills.

In the ten years since its establishment, the State Highway Department of Pennsylvania has had available more than $57,000,000, all of which it is expected will have been expended by the end of next year in the improvements, construction and maintenance of the state highway department system, which by legislative acts includes more than 10,200 miles of important roads connecting county seats and centers of population, out of a total of 100,000 miles of highways in the state. The state system has been again divided into primary and secondary systems, of which the first is a combination of trunk lines, providing six north and south routes and six east and west thoroughfares crossing the state, which is about 400 miles long and 200 miles wide. Of these roads it is expected that by January 1, 1923, approximately 2,000 miles will have new, hard surfaces with a minimum width of 18 feet, a large proportion of them being concreted.

An essential feature of the proper design, construction and maintenance of this great system is the state laboratory, located in Harrisburg, which is equipped and operated mainly for testing road materials and also to control the use of these materials in construction and maintenance work, to make material surveys for the location and classification of construction materials, and for research work to aid the preparation of improved designs and specifications.

Obviously, the work of this department is directly proportional to the amount of construction and has had a very rapid development as indicated by the summary of laboratory tests, which in 1917 amounted to 1603 for 9.47 miles of highway completed; in 1918 to 1951 for 43.94 miles of highway; in 1919 to 6625 for 253.1 miles, and in 1920 to 11,671 for 413.80 miles of highway completed. The tests are made with standard apparatus and appliances and in the manner adopted as standard by the American Society for Testing Materials or, when standards have not been definitely accepted, by the methods tentatively recommended by the Bureau of Public Roads at Washington, D. C.

The testing laboratory occupies a 40x70-foot building, in the first story of which are the executive office and the chemical testing laboratory where oils, asphalt, paint and cement are investigated. A very large number of samples, averaging 600 per month, are received in this laboratory, where great care is taken to label, record, classify, distribute and store them in an accurate and systematic manner that eliminates uncertainty and confusion. This laboratory is well equipped with up-to-date supplies and apparatus.

The concrete testing laboratory in the basement of the building is devoted exclusively to testing stone, brick and concrete, of which it makes approximately 500 tests per month. It has a complete mechanical equipment including a 200,000 lbs. capacity Universal testing machine; two brick rattlers, conforming to specifications of A. S. T. M., a standard impact toughness testing machine, conforming

to specifications of A. S. T. M.; a direct motor-driven diamond drill press; a U. S. standard ball grinding mill; a direct motor-driven combined diamond saw and lap; a direct driven hardness testing machine; a three-gang standard Deval abrasion cylinder machine, to determine the French co-efficient of wear on stone; a specially designed abrasion cylinder, for determining the per cent. of wear on stone; a specially designed impact machine, for determining the properties of concrete, and an impact machine to determine toughness of rock. Also screens and sieves, scales, balances, heating apparatus, wire pulling grips, cold bending apparatus, and various sizes of truncated cone moulds.

The sand and cement testing laboratory in the second story of the building makes about 2,000 tests per month, besides a much greater number of cement tests that are made in special branch offices, established by the department in the centers of the cement manufacturing industry at Allentown and at Pittsburgh, Pa. The equipment of this laboratory includes two 1,000-pound capacity automatic shot cement testing tensile machine, a standard steaming apparatus, a drying oven, three moist closets, a 20,000-pound capacity compression machine, three motor-driven sieve-shaking machines, sieves, briquette moulds, cylindrical moulds, balances and apparatus for silt and colormetric determinations on fine aggregate, sample mixer and storage tanks.

The laboratory, which is under charge of H. S. Mattimore, engineer of tests, is essentially composed of four principal divisions, those of chemical and physical testing, material inspection, bituminous inspection, and administration organization, as indicated in the accompanying chart.

LABORATORY ORGANIZATION, PENNSYLVANIA STATE HIGHWAY DEPARTMENT

- Engineer of Tests / Chemical Engineer
  - Chemical and Physical Testing
    - Sand and Cement — Chemist, Assistants
    - Chemical Laboratory — Chemist, Assistants
    - Physical Laboratory — Physicist, Assistants
    - Research — Chemist, Assistants
  - Administration Chief Clerk
    - Clerical — Clerks
    - Stenographic — Stenographers, Typists
  - Bituminous Inspection
    - Supervising Asphalt Plant Inspector — Road Inspector
  - Material Inspection
    - Eastern Section — Chief Inspector, Material Inspector, Cement Samplers
    - Central Section — Chief Inspector, Material Inspector, Cement Samplers
    - Western Section — Chief Inspector, Material Inspector, Cement Samplers

Great importance is attached to the efficient application of the test results to actual construction operations. This amounts to field control of materials used, by a force of local inspectors trained to observe special qualities and defects in sand, stone, gravel and in other materials, and to determine and insist upon the necessary qualities required by the specifications. These inspectors are also furnished with field testing outfits for sand with which they can maintain constant check on the varying quality of irregular products of local sand pits and thus indicate whether they may be deteriorating or may require special selections or treatment, such as screening, washing or mixing, or if a variation in size demands corresponding change in the proportion of the mixture with other materials.

The preliminary material tests are followed up by tests of samples of finished products such as bituminous surface, specimens of which are taken from the finished roadway and sent to the laboratory to check up the mixture formula and the specified grading of materials; while with concrete surfaces two sets of cylinders, 6x12 inches and 6x6 inches, are moulded from the concrete after it has been placed in the road surface, the large cylinders being tested for compressive strength and the small ones for impact values.

RESEARCH WORK

Although some laboratory research work is carried on continually throughout the year, the most important part of it is conducted in winter when construction is slack or is suspended. At this time the services of the trained employees are utilized for the investigation of important problems which, although generally of great local importance, are in most cases common to highway construction throughout the United States.

A series of experiments are continually in progress for the study of concrete aggregate in order to determine the effect of various precentages of coal, both bituminous and anthracite, in concrete sands, some of which are found in the beds of streams that have received a large amount of waste from colleries that has produced for many miles sedimentation of minute particles of coal, which in some places is so thick and pure that it is reclaimed for fuel, while in other cases the quantity is so small as to have little effect on the qualities of sand that are essential for its use in mortar and in concrete. The concrete sand is also constantly studied to determine the mixture most advantageous to resist the abrasion and impact of traffic.

In bituminous mixtures efforts are made to develop a suitable proportion that will prevent "pushing" under traffic, and will at the same time maintain its life for a long period. Samples are taken from finished road surfaces of all types of bituminous construction and of concrete wearing surface by means of a Calyx core drill, providing samples from which action of the materials and traffic can be determined. In one 10-mile section of reinforced concrete road subjected to heavy traffic during the war, 380 cores were removed, inspected and tested and showed that the wearing surface had suffered almost no deterioration. The specimens tested so high that the usual plaster-paris capping proved inefficient, and has been replaced with cement mixed with an accelerator.

PUBLIC WORKS

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CONTENTS

Effects of Heat on Concrete Pavements

One of the interesting points brought out by the investigations being made on the test highway at Pittsburg, California, is the daily motion of the concrete pavement under the effect of the sun's heat. As the top of the pavement heats first in the morning, it expands first and this causes a warping of the pavement, the top becoming more convex. In the evening, as the subsoil cools less rapidly than the air, the top of the pavement contracts and becomes less convex. This of course results in decreased support, by the subsoil, of the center of the road in the daytime and of the edges at night.

Another effect, due to longitudinal expansion not sufficiently absorbed by expansion joints, is a corrugation or series of waves in the pavement, as a result of which transverse cracks form in the top of the concrete at the crests of the waves and probably in the under side of the hollows.

The data available when our correspondent wrote were by no means complete nor had the tests ended, and no conclusions are warranted, even tentatively; but enough has already been learned to promise most interesting information concerning the actions of concrete pavements under varying load, temperature and subsoil conditions.

Hydrogen-ion Concentration

The term "hydrogen-ion concentration" is finding its way with increasing frequency into the literature of water purification, and those interested in that subject should at least know what is meant by it and the application of the procedure involving the use of the theory that has been given this name. Any filter attendant can, we believe, understand the explanation given in this issue on page 28.

That it is still a new idea to the majority of water works men is indicated by the fact that, in the discussion of the subject before the New England Water Works Association, the chemist and sanitary engineer of the Rhode Island State Board of Health stated that "The question of hydrogen-ion concentration of water is so new as a practical water works proposition that I have had little opportunity to look into it." It is therefore believed that the explanation we print will be welcome to many of our readers.

Co-ordination of Laboratory Tests and Field Inspection for Highway Construction

The construction of any considerable mileage of hard surface roads, particularly those with bituminous or concrete wearing surfaces, requires a thorough laboratory service in the testing of constituent materials to grade them in accordance with accepted standards, establish their conformity to the required specifications, determine if they are satisfactory for acceptance in given construction operations, and to make preliminary investigations of their suitability for proposed work or of modifications in proportioning and treatment that may make them acceptable for revised specifications.

Most or all of the state highway departments recognize this necessity in the development and operation of official testing laboratories, but they do not all attach great importance, or give in every case sufficient weight, to the necessity for a thorough coordination of the laboratory with the current construction operations which, for the best results, should be coordinated with the laboratory by making the inspectors and field engineers constantly and intelligently responsive to the daily local conditions and operations.

In other words, the established theoretical requirements should be continually compared with the construction operations so as to secure thorough and accurate control of the materials actually used and the mechanical processes involved at all local points. The chief essentials to this are to verify the conformity of the materials used with those of the accepted and specified samples, and to check the proportions of different materials and approve the operations of construction so that the value of satisfactory materials may not be impaired or deteriorated by neglect or improper treatment or proportioning.

The quality and proportion of cement may generally be determined by careful continuous supervision of the mixing machine and by proper requirements for hauling, storing and handling the cement that is tested at the laboratory and mills. Bituminous materials require constant testing and inspection at the mixing plant and temperature tests at the site.

Broken stone requires approval of the source, which is usually sufficiently supplemented by careful inspection as to uniformity of product.

Sand and gravel are often procured from local deposits, frequently from many successive ones that are likely to furnish a variable output having great irregularity. The initial samples accepted by the laboratory may be very different from the materials frequently encountered which are likely to have constant minor variations, therefore the local inspectors should be especially trained in the accurate observation of the general characteristics and should be furnished with simple field testing plants enabling them to keep constant watch over the regular deliveries and immediately report any serious variations from the accepted standards, which should be immediately submitted to the engineer in charge and instructions received whether material is to be accepted, or rejected, or the proportions changed.

Such inspection tests in combination with the selection, recording and testing of samples taken regularly from the finished structure will operate to establish the best co-operation between contractor and engineer and secure the greatest advantage from the preliminary laboratory work and the best conformation with the specification requirements and principles of design. It involves very little additional trouble or expense and is an important element in realizing the potential value of the laboratory tests and specification requirements.

Hydrogen-ion Concentration in Water Purification

Comprehensive, concise and clear explanation of what is meant by this new term in water purification nomenclature, and how the idea is employed in regulating coagulant doses.

The introduction of hydrogen-ion concentration in the procedure of water purification by rapid filtration is perhaps the latest development in the science of water purification, or rather in the control of purification, and is as yet understood by few engineers and water works superintendents. The following explanation, written by Harrison P. Eddy of the firm of Metcalf & Eddy, consulting engineers, is the most complete and clear that we have read, and is given here to enable the readers of this paper to obtain a clear idea of a subject to which they will probably see references with increasing frequency in the future. This description was presented by Mr. Eddy as a paper before the New England Water Works Association last September. It was followed by a discussion, from which also a few ideas have been taken to supplement Mr. Eddy's paper.

The term *hydrogen-ion concentration,* for short written also "H-ions" and "PH," may with sufficient accuracy for popular purposes be paraphrased *concentration of acidity or alkalinity,* as the case may be. Pure water is neutral,—that is, neither acid nor alkaline; and its hydrogen-ion concentration is taken at 7. Acidity is designated by numbers below, and alkalinity by those above 7.

The acidity or alkalinity of a liquid has thus far generally been reported in terms of total quantity of acid or alkali present. It has commonly been determined in water by adding acid or alkali of known strength, in sufficient quantity to neutralize the original acidity or alkalinity, the neutral point being indicated by a change in color due to a small quantity of organic dye previously added. But the action of the acid is not due solely to its total quantity but rather to its effective quantity or intensity. The essential difference between this old determination and the new hydrogen-ion method is that the latter shows the intensity, or true acidity, rather than the total quantity of acid.

The function of alum in the process of water purification is to produce a coagulum, or floc, of relatively large size, capable of absorbing or enclosing the finely divided foreign substances which cannot be removed by practicable periods of sedimentation or by filtration at high rates. When absorbed by the alum floc, however, they may be removed readily by sedimentation or by filtration, or by both processes jointly. It is obviously important that the alum introduced into the water be converted into floc as completely as possible.

It has generally been supposed that the precipitation of the sulphate of alumina is dependent primarily upon the presence in the water of sufficient alkali, and that any excess of alkali likely to be present in waters generally used as sources of water supply is not disadvantageous. However, certain experiments indicate that there is an optimum point at which apparently all of the aluminum is thrown out of solution, but that above that point on the side of alkalinity or below it on the side of acidity precipitation is not complete. This offers a plausible explanation of the presence in the water being treated of aluminum both in insoluble and soluble form at the same time and of the frequent occurrence of dissolved aluminum in filtered waters. It certainly indicates that it may be highly important, if practicable, to carry out the coagulation process at the optimum point of alkalinity,—the isoelectric point. Without this determination, or its equivalent, it is impossible to know whether the water has the proper PH. It may be too low or too high for complete precipitation

and it will probably only occasionally be just at the optimum point.

The presence of aluminum in two forms is explained by some according to the theory that the alum assumes a colloidal condition, by which is meant a condition intermediate between solution on the one hand and suspension on the other. Thus we may speak of salt dissolved in water, as a solution, and sand or fine silt suspended in water, as a suspension. The soap in soapy water may be taken as a popular illustration of the intermediate condition—that is, the soap is a colloid. Some substances, like the alum used in purifying water, may be in, or be changed into, any one of these three conditions. The change is one of condition rather than of composition.

Another theory is that the alum may exist as different chemical compounds, some of which are soluble and others insoluble.

Whichever of these theories may be accepted, the important point is that the alum can be converted completely into insoluble aluminum hydrate only within a narrow range of hydrogen-ion concentration, which is not indicated by the methods commonly used for determining alkalinity, and that either above or below this zone the aluminum, or a portion of it, may be present in solution.

It follows, therefore, that it is as important to reduce an alkalinity which is too high as to increase an alkalinity which is too low. This introduces a step in the process of the treatment of water which is not common and which may prove of material value.

It is hardly necessary to point out the fact that the hydrogen-ion concentration appertains to the condition of the water for satisfactory coagulation and is not a method for determining the quantity of coagulant required. This must be done as an entirely independent step in the process.

For ascertaining the isoelectric point the determination of the hydrogen-ions affords a convenient and practical means. This may be accomplished in a manner similar to that long used for the determination of the total quantity of acid or alkali present. Thus, by the use of several indicators constituting virtually a scale of indicators and by the addition of the proper quantity of alkali, or other compound, it is possible to bring the water to the exact hydrogen-ion concentration required for complete precipitation of the aluminum from the alum added to the water. Theoretically, this may be so minutely controlled in practice as to prevent the occurrence of dissolved aluminum in the presence of the insoluble aluminum floc.

As the difference in electrical pressure or potential between any metal and its ions varies with the concentration of those ions, it is possible to determine this concentration by means of suitable electrical apparatus, one form of which is known as the "potentiometer." By the use of the hydrogen electrode,* therefore, it is possible to determine the concentration of the hydrogen-ions.

In order to take advantage of the hydrogen-ion concentration in the operation of a water purification plant, it will be necessary to control the chemical treatment according to several steps, such as—

* Because metallic hydrogen cannot be obtained, an electrode is used which is covered with spongy platinum saturated with hydrogen.

1. Determine the quantity of alum required for successful treatment under conditions prevalent at the time.
2. Determine the PH of the water to be treated.
3. Determine the quantities and kinds of chemicals to be introduced, in order to bring the water to the isoelectric point for coagulation of the aluminum.

The procedure, then, would consist of adding the proper kinds and quantities of chemicals to produce the isoelectric point and the required quantity of alum for the successful treatment of the water.†

The quality of most raw waters varies from time to time,—often materially within very short periods of time. This variation may be in bacterial content, organic matter, numbers of micro-organisms, turbidity, temperature, or in all of these. It is obvious, therefore, that the quantity of alum must be varied to meet the conditions at the time. It is highly probable, also, that the PH varies greatly and that the kinds and quantities of chemicals used to produce the isoelectric point must be varied accordingly. Even if the PH of the raw water remained constant, the necessary changes in the quantity of alum introduced would make it necessary to vary the chemicals required for producing the isoelectric point, as this condition must be fixed with reference to the quantity of alum used; or, in other words, if coagulation is to be complete the water must be at the isoelectric point after the sulphate of alumina has been added.

It has been suggested that the PH of the water may be determined and the application of the conditioning chemicals regulated automatically by electrical apparatus. Such equipment would greatly simplify the control of the process.

Among the advantages which may possibly result from PH control of water purification plants may be mentioned the following:

1. Prevention of passage of alum through filters and after-precipitation in mains.

The passage of alum either in solution or as a colloid through water filters has long been recognized as one of the defects of the alum treatment. Such water is not satisfactory for domestic consumption and is objectionable for certain industrial uses, such as dyeing. It may be possible by chemical treatment to so adjust the PH as to secure complete precipitation of the alum and prevent its passage through the filters.

2. Prevention of corrosive action.

It is possible that the treatment of the water to secure the isoelectric point will reduce the danger of corrosive action by the filtered water, due either to the presence of dissolved aluminum sulphate or to excessive carbon dioxide. The treatment required to produce the isoelectric point in some cases (where acid is required) might not reduce—in fact, it might actually increase—the amount of free carbonic acid present in the water. It does not follow, therefore, that in all cases advantage can be taken of reduction of both of these corrosive substances, although it may be possible to so adjust this treatment as to accomplish this. It is conceivable and has been suggested, however, that in practice water treated in this manner might become more highly corrosive than that treated in the ordinary way.

† In the discussion Mr. Eddy stated that the isoelectric point is not coincident with P-H-7 or the neutrality point, but varies with the material to be coagulated.

3. Control of small plant and animal life.

It has long been known that the growth of microscopic organisms and bacteria is favored by the concentration of acidity, within certain limits, outside of which there is an inhibiting effect. It has been suggested that by securing the optimum PH for precipitation of alum, the environment of such organisms may be so changed as to prove detrimental to them and inhibit their growth. There is scarcely any definite information on this point and it is included herein merely as a suggestion of possible means of controlling growths in filter plants, which in some cases have been quite troublesome.

4. Possible reduction in size of filter plant.

It is a matter of common knowledge among chemists that precipitates formed under certain conditions settle and filter much more readily than those formed under other conditions. There seems to be ground for the belief that alum precipitated at the optimum PH point may form a floc which will settle more readily and permit of more rapid filtration than similar floc formed at a less favorable PH. Should it prove that coagulation at the isoelectric point will produce a floc which will coagulate and settle more readily and permit of a higher rate of filtration, a corresponding reduction in size of coagulation basins and filters might prove a substantial advantage. While it is conceivable that the change in the character of floc, due to PH control, might warrant a change in the depth of filtering material or in some other detail of construction, this does not appear at all probable.

5. Possible increase in efficiency of operation.

If coagulation at the isoelectric point will result in the formation of a better floc and in avoiding the passage of dissolved aluminum through the filters, it may be that the bacterial efficiency of filtration will be improved to some extent. It seems reasonable to expect such a result from observation of the process of coagulation.

While these and perhaps a number of other advantages of the PH control may be possible from a theoretical point of view or may be obtained in the laboratory, it is important to prove to what extent, if any, they can be secured in the practical operation of water purification plants.

There is little doubt that the determination of the hydrogen-ion concentration will permit of a more intelligent study of the water and the reactions taking place during its treatment. This fact alone is sufficient to warrant making a thorough investigation of the subject and determining the PH value in many cases.

It is possible that the methods of control now in use, based in part upon the older conceptions of the chemistry involved and in part upon practical operating experience, permit of as close operation of purification plants as it is possible to obtain, even with the assistance of the more delicate and refined hydrogen-ion determinations made in accordance with the latest theories of chemistry.

It often happens that empirical methods lead to practical results which are as satisfactory and effective as those based upon more accurate knowledge. This fact, however, does not justify disregard of progress in science and of new theories. It cannot be gainsaid that the older practitioners in any profession, or in the arts, are inclined to adhere to the older methods and processes as a result of their familiarity and experience with them and a natural reluctance to adopt new ideas. The older members of the profession should constantly guard against this tendancy, in order that valuable improvements may not be ignored, simply because they involve new discoveries and new theories.

While it is wise to give proper weight to the reasonable doubt of success in order not to be misled by theoretical considerations, it is certain that the subjects of coagulation and filtration should be very thoroughly studied in the light of the more modern chemical theories. Such investigations will lead to a better understanding of the chemistry of coagulation than that which has governed this important subject in the past. With improved conception of the process, advantages of more or less importance are likely to follow. The true value of the hydrogen-ion determination can only be learned through investigations covering a great variety of conditions encountered at a large number of plants.

Such investigations may well lead to a re-study of the whole subject of chemical treatment of water, and improvements may result in lines entirely apart from the hydrogen-ion determination.

In discussing this paper, Frank W. Green, superintendent of the Little Falls filtration plant of the Montclair Water Co., defined hydrogen-ion concentration, as applied to natural waters, as being "the measurement of the minute amount of hydrogen which is present in the ionic state due to electrolytic dissociation. Pure water has a value of P.H.-7.0, but natural waters may vary from 6.0 to 8.0. Although present in almost inconceivably small quantities, its determination is of considerable value because coagulation, corrosion, and other important reactions take place in definite zones of hydrogen-ion concentration. The result obtained for any given water depends upon the proportions of the contained amounts of certain acids and bases, those of greatest influence in normal supplies of this region being the free carbonic acid and the bicarbonates. So important are these two constituents that $3CO_2$ divided by HCO_3 will give a rough approximation of the H-ion concentration."

Mr. Green said that "the actual determination of the PH value of a given water is one of the most simple tests that the water analyst has to perform, provided he takes advantage of the permanent standards and indicator solutions now on the market. The test consists in adding a few drops of the indicator to the water sample and comparing its color to that of the standards." The theoretical side of the subject, however, is very complex and difficult and can be undertaken only by the most skilled specialists.

With reference to actual use of this method, Mr. Green stated that "for routine work, quite accurate results can be obtained by use of the sets of Brom thymol blue standards with a range of 6.0 to 7.6 and phenol red series of 6.6 to 8.2 in sealed test tubes. Bottles of solutions of the two indicators and color charts to insure that the standards are correct can be purchased for a small amount. Take 10 c.c. of the water to be tested, add a few drops of the indicator, and compare with the permanent standards.

Constructing Wichita Falls Sewers

Thirty-six miles of machine trenching up to twenty-two feet for sewers six to thirty-nine inches in diameter. Four excavating and three backfilling machines used on $750,000 job.

The new sanitary system of Wichita Falls, Texas, has just been installed in about fourteen months by C. R. Nichols, Wichita Falls, Texas, at a contract price of $750,000, the largest undertaking of its kind that has yet been accomplished in the state of Texas.

Starting at the outfall with 6,800 linear feet of 39-inch segment block sewer and a maximum depth of 22 feet, the system includes 6,000 feet of 36-inch, 4,000 feet of 33-inch, 4,000 feet of 30-inch, 8,000 feet of 24-inch, 11,000 feet of 18-inch, 14,000 feet of 15-inch, 7,600 feet of 12-inch and 100,000 feet of smaller sewers.

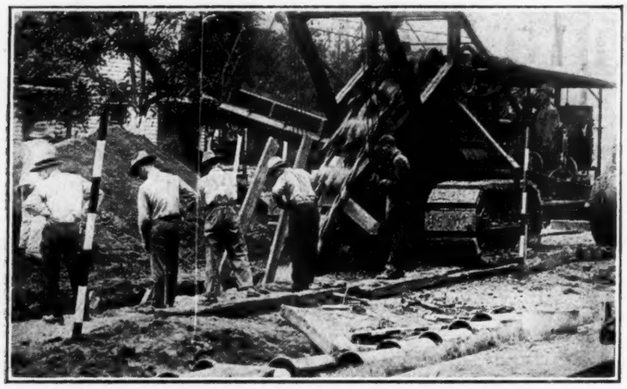
The trenches were excavated chiefly through hard red clay with some quicksand, by four Bucyrus, Austin and Buckeye excavating machines. The widest and deepest trenches, those for the 39 to 33-inch sewers inclusive, were excavated by a Bucyrus Class 72 machine, weighing 99,000 pounds that made a record of 61½ linear feet of completed trench 5-feet wide and 21-feet deep in 60 consecutive minutes and has made an output of 333 cubic yards per hour in hard clay. The machine is equipped with a 20-foot ladder, for buckets 24 to 72 inches wide, although 48-inch buckets were the smallest used on this job. The spoil was handled by an independent conveyor engine making it possible for the operator to regulate the location of the spoil pile and dump the material far enough from the center of the trench to prevent overloading the bank and consequent caving in of the side of the trench. The trench for the 18-inch sewer was excavated by an Austin machine; that for the remainder of the sewers was excavated by Buckeye machines.

Between November 23, 1920 and February 14, 1921 the total machine excavation amounted to 90,581 cubic yards for which the cost, exclusive of repairs and depreciations was only $3,719.90 including labor and fuel. The center of the spoil bank was maintained from 12 to 18 feet from the edge of the trench and the soil was so dry and firm that the sides stood vertical although sheeted, where the trench was more than 10-feet deep, with vertical 2 by 12-inch planks, not close together, braced with screw extension, horizontal struts set directly against the planks or set against waling strips 5 feet apart vertically.

The bottom of the trench was trimmed by hand to a concave surface corresponding with the sewer inverts and the center line of segment blocks was laid and tamped to grade and the longitudinal courses on both sides were laid simultaneously and tamped up to the spring line, after which forms 12 feet long were set and the arches were built on them, the forms collapsed, and advanced as fast as the trench was excavated, thus completing the sewers as fast as the digging permitted. The trench was backfilled with

BUCKEYE MACHINE CUTTING SEWER TRENCH 30 INCHES WIDE, WITHOUT SHEETING. BACKFILL FOLLOWS CLOSELY

BUCYRUS MACHINE EXCAVATING 60-INCH TRENCH 20 FEET DEEP FOR SEGMENT BLOCK SEWER. BACKFILLED BY MACHINERY



BUCKEYE MACHINE EXCAVATING NARROW SEWER TRENCH 10 FEET DEEP

three Austin, and one Buckeye machine, one Cletrac tractor and one Holt tractor.

The force employed varied from 50 to 150 men under the direct charge of C. R. Nichols, assisted by R. C. Nelson, chief engineer; C. C. Key, office engineer; W. A. McRae and W. L. Robb, superintendents, and J. L. Poole, master mechanic. During construction several changes occurred in the personnel, and D. T. Ferrell succeeded C. C. Key, and M. M. Buchanan succeeded W. A. McRae.

Reservoir Storage for Kansas—Colorado Water

Report of Committee of Kansas Engineering Society on joint state action for conserving flood waters of the Arkansas River.

The Arkansas river is used by both Kansas and Colorado as a source of water, for irrigation chiefly. A large percentage of the water is lost during flood times because there are practically no storage basins, either natural or artificial. Effort is being made to obtain combined action by the two states which would result in the construction of reservoirs for storing flood waters to the advantage of both states, but chiefly of Kansas, during seasons of minimum stream flow.

The possibilities are being studied by engineers and state officials, and a committee of the Kansas State Engineering Society, consisting of G. S. Knapp, H. B. Walker and O. E. Noble, has recently reported on the subject. The following quotations and abstracts are from that report:

PHYSICAL CONDITION OF RIVER FLOW

"According to records from the river gauge maintained by Colorado on the Arkansas river at Holly, and which are now available for the ten year period, 1911 to 1920, inclusive, there is an average annual flow across the state line into Kansas of about 220,000 acre feet of water annually. The largest amount was 555,955 acre feet in 1914, and the smallest 54,557 acre feet in 1917. There were only two years when the total flow was less than 100,000 acre feet. No general tendency to either increase or decrease is evident.

"Without storage a large part of this water is lost because it comes outside the irrigating season or in floods of such volume that all of the Kansas ditches can divert but a small part of the flow. Complete information on the total combined capacity of the Kansas ditches is still lacking, but it is probably not far from 650 cubic feet per second. Assuming this figure correct, and that when the river flow drops below 40 cubic feet per second it will not make an irrigating 'head,' an examination of the daily gauge records for the period in question shows that the Kansas canals probably received an average of only 68,000 acre feet of water annually, or only about 1.13 of an acre foot per acre for the land under them, not deducting canal losses between the point of diversion and the land. The largest part of the water, 153,000 acre feet, or approximately 70 percent was lost for the reason that it either came out of the irrigating season or in such large volumes that the canals were able to take only a small portion of the flow. The largest loss was by summer floods, amounting to an average of 95,700 acre feet annually. Winter flow amounted to an average of 57,900 acre feet. There was a greater regularity in the amount of winter flow than of summer flow, but even the latter was subject to considerable variation. The largest flow for the five winter months in any year was 82,500 acre feet in 1912, and the smallest 27,700 acre feet in 1918.

"With the exception of 1914 and 1915, which were flood years compared with the past year in volume of water, almost the entire flow of the river could have been controlled by storage. If stored, the water would have been more than enough for the land now under ditches. Lack of adequate reservoir sites has made storage of the water after it reaches Kansas impossible, and Colorado laws forbidding the removal of water from the state have in the past prevented storage in Colorado for use in Kansas.

RESERVOIR POSSIBILITIES

"The Purgatorie river in Colorado seems to offer the most promising solution of the storage problem. This stream is one of the larger tributaries of the Arkansas in Colorado. It rises in the high mountains west of Trinidad, and flows in a northeasterly direction for one hundred and forty-five miles, entering the Arkansas below Las Animas, sixty-five miles west of the Kansas-Colorado state line. Because of the topography of the surrounding country, and the fact that it enters the Arkansas below the headgates of most of the Colorado ditches, this stream has been less extensively developed for irrigation than most other Colorado streams. Above Trinidad the country is mountainous. Twenty-five miles below Trinidad the stream enters a rocky canyon, the walls of which are more than three hundred feet high, and it does not emerge from this canyon until it has nearly reached its junction with the Arkansas. Immediately below Trinidad the valley for a short distance is comparatively broad and level. Here there is a considerable acreage of irrigated land. Farther down,

about fifteen miles above Las Animas, the canyon widens into a valley a mile or more in width. At this point there are two small appropriations for use on the bottom land adjacent to the stream.

"Few measurements of stream flow have been made on this stream. It is well known, however, that the Purgatorie, like most mountain streams, is subject to sudden floods of great volume, and on the other hand, has but little dry weather flow. Records available for the three years, 1910 to 1912, inclusive, at Trinidad, show an average flow of 69,500 acre feet of water. None of these years were flood years. It is probable that the discharge in flood years is much greater, and it is also probable that there have been years when the annual flow has been less than the above amount."

The Purgatorie has two very good reservoir sites, one just above the point where it enters the canyon, where a dam 250 feet high would impound 1,367,000 acre-feet of water—more than the capacity of the Roosevelt reservoir. The other site is thirty-five miles lower down, at the junction of Chauquaqua creek with the river. Here a dam 150 feet high would impound 605,000 acre-feet.

Other sites have been located at Medway and at Hartland, Kansas, but these are not nearly so advantageous. Near Lakin, Kansas, is a reservoir that has been in use for some years and would be of some value in connection with the water problem.

Chlorination Tastes and Odors

Experiences at the filtration plant at Grand Rapids, Mich., from 1917 to 1921, were discussed in a paper before the American Water Works Association by Walter A. Sperry and Lloyd C. Billings, chemists of that plant. In this paper the writers reviewed their experiences with chlorine disinfection during the five years named and their success in eliminating tastes and odors in the water that were occasionally caused by chlorination.

In view of certain features in design of the plant and quality of the raw water, it was found necessary to add the chlorine at a point between the settling basins and the filters. During 1918 and 1919, when complaints regarding taste and odor had occurred, liquid chlorine was being used entirely or in conjunction with hypochlorite. In 1920 hypochlorite alone was used and there was no trouble from tastes and odors. Investigations showed that the trouble had been due to the fact that, when applying liquid chlorine (which is a 100% solution), a small fluctuation in dosage was sufficient to exceed the narrow range between the amount of chlorine required for proper disinfection and that necessary to produce taste; while in applying hypochlorite, of which much larger quantities are used because of its lower chlorine content, it was easier to keep within the narrow range between these two points.

In 1920 and 1921 laboratory tests were made to determine the proper methods of feeding the chlorine by laboratory control rather than at a constant rate. It was found that a modification of Wolman and Enslow's chlorine absorption method gave a satisfactory disinfection result without taste and odor complaint. The method referred to is based on the hypothesis that "a proper dosage for the effective disinfection of a water is the amount equal to that absorbed by the water tested after contact of five minutes plus a factor of safety to 0.2 p.p.m. (as a tentative value)."

Judging from their own experiments, the writers did not believe that 1.1 p.p.m. of chlorine could be left in the Grand Rapids filtered water without producing taste, although certain tests for residual chlorine and taste appeared to indicate the contrary. They concluded from their experiences that "the whole problem of chlorine tastes as applied to filtration practice is related to improperly proportioned dosages."

Asphaltic Concrete Foundations

The following is part of a letter by P. J. M. Larranaga, of London, published in "Municipal Engineering and the Sanitary Record" for December 22, as part of a series of letters on that subject which are appearing in the "Correspondence" columns of that periodical:

"The fact that a certain type of construction has stood the traffic of years gone by does not prove its efficiency under the impact of modern traffic. Water-bound macadam has served its time and passed out, and it is now the turn of the rigid foundation to pass out, because the heavy motor truck has brought a new destructive force, the impact of concentrated loads, to bear upon road surfaces.

"It is no longer a question of static loads rolling along, or of self-propelled vehicles disturbing the crust of the road. These forces have been attended to. The question now is how to devise a means of resisting the terrific hammering and pounding that a road surface receives. An ordinary omnibus rider can testify to the existence of this force, but what he feels is greatly attenuated by the springs of the vehicle. There remains, however, a great amount of unsprung weight of vehicles, the impact of which, plus the reaction of the springs, has to be absorbed by the road surface. Is it not clear that the road surface material should likewise be cushioned?

"When we lay a concrete foundation we actually build a rigid bridge, when we should instead be providing only a resilient yet stable medium for transferring the load to the bearing soil of mother earth, which is the ultimate foundation.

"Bituminous structures develop great slab and beam strength, as measured by their resistance to impact. The all-asphalt slab and beam offer considerably more resistance to impact than an equivalent thickness of 1 : 3 : 6 Portland cement concrete, considered either as an integral structure or as a foundation for a bituminous wearing surface. It is uneconomical and impracticable to try to secure a permanent bridging of weak sub-grade. Though the bituminous type of construction has been found to develop such action to a considerable extent, it is characteristic of it that it eventually seeks to maintain contact with the sub-grade, thus to reinforce itself with the maximum supporting value of the latter. The rigid type cannot do this and will therefore crack if unsupported.

"Nor can this be improved by making the concrete mixture richer, for while the beam strength may increase, the expansion and contraction stresses increase much more, and with them the resulting

liability to cracking on that account alone. We say nothing of the much greater cost of such rich concrete.

"In conclusion, it cannot be too often repeated that the first and most important consideration in all road construction is to increase the bearing power of the subsoil to the maximum by providing proper drainage with uniform and thorough compaction. Where a very poor clayey soil exists, difficult to drain, and having great capillary attraction for water, it is often more efficient and economical to modify the character of the subsoil to a sufficient depth by mixing with sand or other suitable material, than to embark upon an expensive and massive design to bridge the defect.

"Concerning the suitability of an asphaltic foundation for an asphalt surface, the preceding arguments are reinforced by the consideration that in such a case we secure perfect adhesion between surface and foundation and a practically homogeneous structure throughout."

In England nearly all the sheet asphalt, except in the city streets with the heaviest traffic, is now being laid on bituminous concrete base, and this method is said to be satisfactory because of the existence of a firm sub-base of old macadam.

Nearly One Thousand Miles of Roads Constructed in Kentucky in Two Years

The fifth bi-annual report of the Kentucky State Highway Department shows that 990 miles of various types of roads were built during the years 1920 and 1921. Of this amount about 300 miles were surface treated old macadam road and 690 miles were new and resurfaced roads. About one-half more work was done this year in 1921 than 1920. Lack of co-operation between the prison and road departments, as well as the decrease in wages for free labor from \$5.00 to \$1.50 per day in some localities, has caused the State Highway Commission to discontinue the use of convict labor. In 1920 about 29½ miles of convict-built road cost about \$6,000 per mile while in 1921 about 34 miles cost more than \$10,000 per mile.

During 1921 the State Road Department received \$1,350,000 from county appropriations and private subscriptions, a larger sum than almost any other state in the union has received from similar sources. In 1921 the state also received \$1,951,755 from Federal Aid allotment.

Snow Removal on New Jersey State Highways

There are about 725 miles of road in the New Jersey State Highway System, and the State Highway Commission plans to keep 402 miles clear of snow during the coming winter. This portion of the system is divided into 31 sections from 9 to 17 miles long and each section is provided with three 2-ton or 5-ton Nash 4-wheel-drive trucks with a Good Roads snow plow attachment for each.

Each section is assigned to a principal contractor who has work for the department or other work in the vicinity, and keeps in constant touch with the central office, from whom he receives notice eight or ten hours in advance of the approach of a severe snow storm. When he receives the snow call he immediately assembles his organization and proceeds to the truck station and awaits a 2-inch depth of snow to commence operations. If it proves to be a false alarm he is paid for the time of waiting.

Sustained Rapid Concrete Highway Construction

The construction of 8.3 miles of 20-foot concrete highway on Route 6 of the New Jersey state highway system between Shirley and Bridgeton during June, July and August of last summer, involved laying 23,000 cubic yards of concrete, besides making 15,000 yards of excavation and building 5,547 linear feet of combined curb and gutter 5 feet wide, together with ordinary draining and guard rail work. The contract was awarded June 1st to the Tri-State Construction Co., Bridgeton, N. J. Grading was commenced the next day, the first equipment was installed June 19th and the first concrete was laid July 6th. In the first week 785 linear feet of concrete was laid by a totally inexperienced crew and foreman, in the second week 854 feet, and by the fourth week an average progress of 300 linear feet per day was maintained.

Two Ransome No. 21 caterpillar mixers were used. One of the mixers was worked on double shift, the first gang working from 4 a. m. until 12 noon, and the second from noon until 8 p. m., finishing by artificial light. This mixer laid 25,600 linear feet of pavement in 75 working days.

A third Ransome mixer was kept in reserve. The other principal equipment installed included seven Plymouth locomotives, 30,000 feet of 24-inch industrial track with 8 switches, 62 cars and 124 batch boxes by the Light Railway Equipment Co., one 5-ton Best tractor, one 10-ton Holt tractor, one Adams scarifier grader, two Marion No. 21 steam shovels with clamshell bucket, to unload sand and stone, one Keystone grader and two 10-ton steam rollers.

Aggregate was loaded into the batch boxes through gates in the roof of tunnels carried under the stock piles of 2,000 tons capacity for stone and 1,000 tons for sand. The three mixers and the industrial track were maintained in excellent condition by a 23-man track gang constantly on duty and the trains were run on schedule at a speed of 8 miles per hour.

Grading was done with 32 men, 3 foremen and 6 teams, the hauling equipment was operated by 16 men, one foreman and 16 men were maintained at the unloading plant, and 81 men and 3 foremen operated the two mixers, set the forms, did the fine grading and other work connected with concreting. The total maximum force employed was 167 men, 9 foremen and one superintendent. The concrete materials actually used corresponded with those theoretically required within 0.014 per cent. The work was executed under the direction of J. A. Williams, division engineer in charge of state highway construction in southern New Jersey, with a local force consisting of a 3-man survey party and 6 inspectors constantly on the work.

Recent Legal Decisions

OWNER'S COMPLAINT THAT ADVERTISEMENT FOR BIDS EXCLUDED ALL BUT SUCCESSFUL BIDDER NOT CONSIDERED

In a suit against a construction company and the city of Albuquerque to enjoin road construction work, the New Mexico Supreme Court holds, Ellis v. New Mexico Construction Company, 201 Pac. 487, that complaint to the effect that the advertisement for bids contained such terms that only the defendant construction company could have proposed to do the work and could have performed could not be considered, there being no allegation of fraud or collusion, or of injury to the plaintiffs or any property owner interested, or of other substantive facts which would go to negative the presumption that the city performed the duty imposed upon it by statute by letting "the contract for the doing of such work and the furnishing of all necessary materials to the lowest bidder." The allegations of the complaint were not necessarily inconsistent with the actual performance of the duty imposed.

ANNEXED PROPERTY MUST BE PROPERLY SUBJECT TO ANNEXATION TO VILLAGE

The Minnesota Supreme Court holds, State v. Village of Buhl, 184 N. W. 850, that, in a proceeding under Gen. St. 1913, §1800 et seq., to annex territory to a village, the property annexed must be so conditioned as properly to be subjected to village government. Whether it is so conditioned is primarily for the voters; but if their action is clearly arbitrary, for the purpose of increasing sources of revenue rather than of subjecting to the local village government property having a natural connection with it and people residing thereon having a community of interest, the courts will not sustain it.

MUNICIPALITY CANNOT ACQUIRE SEWERAGE DISPOSAL PLANT IN ANOTHER MUNICIPALITY WITHOUT CONSENT OF LATTER

The New Jersey Court of Errors and Appeals holds, North Jersey Utilization & Sewerage Disposal Plant v. Van Buskirk, 115 Atl. 215, that, under the New Jersey Home Rule Act, a municipality cannot maintain proceedings to acquire land for a sewage disposal plant in another municipality without the consent of the governing body of the latter municipality and its board of health, or, in case of their refusal, without the reversal of such refusal by the State Department of Health. It is immaterial that the object is to acquire a plant already completed, in place of land on which to construct one. The lands desired in this case are part of the territory formerly occupied by the army cantonment called Camp Merritt, on which army engineers built a complete disposal plant.

LIMITATION OF TIME FOR ACTION FOR INJURY TO LAND FROM DRAINAGE SYSTEM

The Illinois Supreme Court holds, Schlosser v. Sanitary District of Chicago, 132 N. E. 291, that injury caused to land by the existence and duly authorized operation of the drainage canal of a sanitary district, which canal is a permanent structure, whose use and operation in such manner are necessarily injurious to the land, is a permanent injury, and all damages therefrom, future as well as present, must be recovered in one action, to be brought within five years after the completion of the work and putting it in operation.

CARRIAGE OF WATER BY ONE UTILITY FOR ANOTHER NOT A PUBLIC UTILITY SERVICE

The Colorado Public Utilities Commission holds that the carriage of water by one utility for another is not such a service as is contemplated in the terms of the Colorado Public Utilities Act, so as to make such service the subject of regulation and control of the Public Utilities Commission; and that the City of Durango is not performing a public utility service when it is carrying water for and to Animas City when such water is owned by Animas City.

TAXATION OF STREET RAILWAY PROPERTY

The Washington Supreme Court holds, Puget Sound Power & Light Co., 201 Pac. 449, that Laws 1907, c. 78, §12, as amended by Laws 1911, c. 21, providing for taxation of operating property of street railroads as personal property, is not violative of constitutional provisions as to uniformity of taxes, notwithstanding the taxation of the land of commercial steam railroads as realty. There is no vested right, either in a corporation or natural person, to have property assessed in any particular way. Such matters rest entirely within the control and discretion of the Legislature. It is a question of uniformity and equality in the classes. That there is ample reason for the classification made by the statute in this case is easily seen. Street railways have no fee in the streets, and their properties are largely personalty, while the commercial steam railways own their rights of way, and own extensive freight yards, terminal and station grounds.

INSUFFICIENT NOTICE OF INJURY FROM DEFECT IN STREET

The Wisconsin Supreme Court holds, Hogan v. City of Beloit, 184 N. W. 687, that a notice to a city that the plaintiff had, on a certain day and specified street, sustained a described injury to her wrist and that a doctor had set it, and "will advise you later as to expense" did not state that "satisfaction therefor is claimed of such city," as required by Wisconsin St. 1910, §1339, and was insufficient. There is a very material difference between a casual notice in writing that an injury has been sustained by reason of a defective street and that expense has been or will be incurred and a notice which makes a claim that satisfaction is demanded. It was held not enough that such notice was given the city that its officers could by investigation have ascertained all the facts, since that is not the only purpose of the statute. The fact that the claim was drawn by the city engineer at the instance of the claimant's son did not constitute waiver by or estoppel of the city; such act not being in performance of any duty to the city.

NEWS OF THE SOCIETIES

CALENDAR

Jan. 17-19 — IOWA ENGINEERING SOCIETY. 34th annual meeting. Sioux City. Secretary—Lloyd A. Canfield, Des Moines, Ia.

Jan. 17-19—ASSOCIATED GENERAL CONTRACTORS. 3rd annual meeting. Hotel Winton, Cleveland, Ohio.

Jan. 17-19—ASSOCIATED BUILDING CONTRACTORS OF ILLINOIS. Chicago, Ill.

Jan. 17-20—ASSOCIATION OF CANADIAN BUILDING AND CONSTRUCTION INDUSTRIES. 4th annual conference. Royal Connaught Hotel, Hamilton.

Jan. 17-20 — AMERICAN ROAD BUILDERS' ASSOCIATION. Annual Convention and good roads show. Chicago, Ill.

Jan. 18—ASSOCIATED ENGINEERING SOCIETIES OF ST. LOUIS. Annual meeting. Secretary, Miss C. B. Adams, 3817 Olive St., St. Louis.

Jan. 18—SIOUX CITY A. A. E. Joint meeting with the Iowa Engineering Society convention. Sioux City, Ia.

Jan. 18-19—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual meeting. New York City.

Jan. 19-20—INDIANA ENGINEERING SOCIETY. Annual meeting. Purdue University, Lafayette, Ind.

Jan. 20—BRIDGE BUILDERS' AND STRUCTURAL SOCIETY. New York City.

Jan. 20 — SOCIETY OF AMERICAN MILITARY ENGINEERS. Washington, D. C.

Jan. 24-26—ILLINOIS SOCIETY OF ENGINEERING. 37th annual meeting. Decatur, Ill.

Jan. 27 — NEW YORK SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies' Bldg., New York City. Secretary—G. I. Rhodes, 115 Broadway, New York City.

Jan. 27-28 — WESTERN PAVING BRICK MANUFACTURERS' ASSOCIATION. Kansas City, Mo.

Jan. 27-28—ARKANSAS CHAPTER, A. A. E. Little Rock, Ark.

Jan. 30—SOCIETY OF AMERICAN MILITARY ENGINEERS. Washington, D. C.

Jan. 30-Feb. 1—NATIONAL CIVIC FEDERATION. 22d annual meeting. Hotel Astor, N. Y. C.

Feb. 4-11—ST. PAUL BUILDING EXCHANGE EXPOSITION. St. Paul, Minn.

Feb. 12-17 — CONFERENCE OF HIGHWAY ENGINEERING, 8th annual conference. University of Michigan, Ann Arbor, Mich.

Feb. 13-16—AMERICAN CONCRETE INSTITUTE. Annual Convention, Cleveland. Secretary, Harvey Whipple, 814 New Telegraph Bldg., Detroit, Mich.

Feb. 14—ENGINEERING SOCIETY OF BUFFALO. Iroquois Hotel, Buffalo. Secretary—N. L. Nussbaumer, 80 W. Genessee St., Buffalo.

Feb. 15-17—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Tenth midwinter convention. Engineering Societies' Bldg., New York City.

Feb. 21-22 — KENTUCKY ASSOCIATION OF HIGHWAY CONTRACTORS. Annual meeting. Louisville. Secretary, D. R. Lyman, 523 Court Place, Louisville, Ky.

Feb. 21-23 — MINNESOTA FEDERATION OF ARCHITECTS AND THE MINNESOTA SOCIETY OF CIVIL ENGINEERS. First annual convention, Curtis Hotel, Minneapolis.

Feb. 22—AMERICAN BUILDING EXPOSITION. Municipal Auditorium, Cleveland, Ohio.

Apr. 19-21 — TRI-STATE WATER AND LIGHT ASSOCIATION OF THE CAROLINAS AND GEORGIA. Spartansburg, S. C.

Apr. 27-30—BUILDING OFFICIALS' CONFERENCE. Apr. 27-28, Cleveland, O.; Apr. 29, Massillon, O.; April. 30, Youngstown, O.

May 15-19 — AMERICAN WATERWORKS ASSOCIATION. Annual convention. Philadelphia, Pa.

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. 8th Annual Convention. Salt Lake City, Utah.

AMERICAN ROAD BUILDERS' ASSOCIATION

The Road Builders annual convention and the Good Roads Show will be held in the Coliseum, Chicago, Jan. 17-20. The tentative program provides for a classification of subjects and papers by sessions including the following:

Session Devoted to Bituminous Roads

"'Bituminous Foundations":—Hugh W. Skidmore, C. E., Chicago Paving Laboratory. "Selection of Bituminous Wearing Course":—S. M. Pinckney, Chief Engineer, Bureau of Highways, Borough of Manhattan, N. Y. C. "Utilization of Local Material for Mineral Aggregate":—Major W. A. Welch, Chief Engineer, Palisades Interstate Park Commission, New York. "Asphalt Specifications":—L. M. Law, Chief Chemist, New Orleans Refining Company. "Specifications of Mineral Aggregates"—Roy M. Green, Manager, Western Laboratories, Lincoln, Neb. Requirements in Specifications":—Bruce Aldrich, Toronto, Canada. "A Simple Graphic Method of Proportioning Sands for Sheet Asphalt Mixtures":—Prevost Hubbard, Chemical Engineer, The Asphalt Association, New York City.

Session Devoted to Portland Cement Concrete Roads

"The Selection of the Mineral Aggregate for a Portland Cement Concrete Road":—John H. Mullen, Chief Engineer, State Highway Department of Minnesota. "Design of Concrete Roads for Heavy Traffic":—W. D. Uhler, Chief Engineer, Pennsylvania State Highway Department. "Inspection and Control of Materials for Concrete Roads":—R. W. Crum, State Testing Engineer, Iowa State Highway Commission. "Importance of Surface Finish and Methods of Control':—H. E. Breed, Consulting Engineer, New York City. "Single Track Concrete Roads for the Average County":—P. C. McArdle, County Superintendent, Vermilion County, Danville, Ill. "Pavement Widths for Highways Serving Large Cities":— Edward N. Hines, Chairman, Board of County Road Commissioners, Wayne County, Detroit, Mich.

Session Devoted to Common Roads

"Common Roads":—T. J. Wasser, State Highway Engineer, Trenton, N. J. "A systematic Study of Gravels for Road Purposes":—Wallace F. Purrington, Chemist & Testing Engineer, New Hampshire State Highway Department.

Session Devoted to Highway Financing

"The Proposed Wisconsin Plan of Highway Finance":—A. R. Hirst, Chief Highway Engineer, Wisconsin Highway Commission. "The Minnesota Experience in Highway Financing":— C. M. Babcock, Commissioner of Highways, Minnesota Highway Department.

Session Devoted to Highway Traffic and Highway Transportation

"Truck Overloading, Its Relation to Road Construction and Maintenance": —J. G. McKay, Ph. D., Professor of Economics, University of Wisconsin.

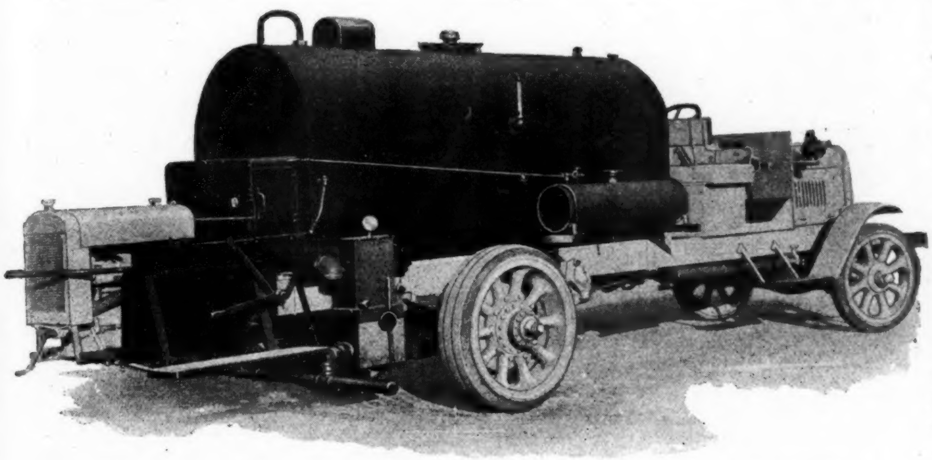
Session Devoted to Highway Research

"Highway Research":—W. K. Hatt, Professor of Engineering, Purdue University; Director of Research, National Research Council. "The Illinois Experimental Road":—Clifford Older, Chief Highway Engineer, Department of Public Works, Illinois. "Highway Researches and what the Results Indicate":—A. T. Goldbeck, Chief, Testing Division, U. S. Bureau of Public Roads, Washington, D C. "The Highway Outlook"—Thomas H. MacDonald, Chief, U. S. Bureau of Public Roads, Washington, D. C. "Cost Keeping on Highway Construction":—A. R. Losh, Assistant Bureau of Construction, U. S. Bureau of Public Roads, Washington, D. C. "Development of Small Stream Valleys into Traffic Routes":—Jay Downer, Chief Engineer, Bronx Parkway Commission, New York. "Uniform Legislation as Affecting Highway Traffic and Highway Transport":—D. C. Fenner, Manager, Public Works Department, International Motor Co., New York City. "Construction and Maintenance of Earth Roads":—George E. Johnson, Secretary of Public Works, Lincoln, Nebraska. "Highway Construction on the Pacific Coast":—Herbert Nunn, State Highway Engineer, Salem, Aregon. "Cooperation of All Parties Interested in the Construction of a Modern Road":—William Ord, Manager, Paving Department, The Lakewood Engineering Co., Cleveland, O. "The Business End of a State Highway Department":—Charles M. Upham, State Highway Engineer, North Carolina State Highway Commission. "The Highway Contractor's Problems": —H. H. Wilson, Winston Brothers, Muncy, Pa.

(Continued on page 38)

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



ASPHALT DISTRIBUTOR ESPECIALLY ADAPTED FOR ROAD WORK

ROAD BUILDERS' ETNYRE ASPHALT DISTRIBUTOR

E. D. Etnyre & Co., who for years have manufactured road oiling equipment, have developed and perfected a new model asphalt distributor, that will handle all grades of bituminous material, and is especially adapted for road building, as it will heat materials to their respective working temperatures, and will apply under pressure any desired amount up to three gallons per square yard. It can be used with equal efficiency for surface coating as well as for road oiling.

Machines will be furnished complete, as shown in the cut, with or without cab top, or the distributor only furnished for mounting on any make of truck. The distributor is a complete unit, built on its own frame, can be quickly applied and removed, so that the truck can be utilized for double service.

The 750 gallon tank, suitable for 3½ ton truck, is the standard, but any size can be supplied to correspond to the capacity of the truck for which it is intended.

Among the important features, which are special in this model are:

1. The tank is completely enveloped with asbestos for the purpose of conserving heat.
2. An auxiliary heater quickly melts any material that may solidify in the pump or discharge line, while machine is standing idle, and which also maintains the proper heat at these points while in operation.
3. Large capacity pump that will discharge 200 gallons of material per minute, 750 gallons in less than four minutes, that will clean the pipe line and nozzles by pumping air, will gll the tank from supply tank when below its own level, or can be used to transfer material from one tank to another.

The distributor consists of heavy steel tank, with seams welded, provided with manhole, overflow pipe and heating flues. The heat is supplied by non-carbonizing kerosene burners and is applied to the material in the tank through the flues and to the ends and lower half of the tank, giving very large heating surface. The flame, being directed through the flues, does not come in contact with the tank, which eliminates the daner of injuring the metal.

The pump is of the rotary gear type and driven by a 4-cylinder, vertical water cooled motor, through steel and rawhide gears. Motor is equipped with high tension magneto and disc clutch and is cooled by radiator circulation and fan. A noiseless flexible coupling is used between the engine and drive shaft.

The distributing line is made up of 2 4-ft. sections of 2-inch pipe, etch section being controlled independent of the other, equipped with nozzles spaced so as to give a double lap. Strainers, which can be quickly cleaned, placed in the line prevents nozzles from clogging. Spray bars are attached by unions, and can be easily removed. Pressure and temperature gauges are furnished with the distributor.

The manufacturers claim that in this model they have combined simplicity of design, substantial construction, light weight, ease of operation and that it will perform the work for which is it intended in a first class manner.

AN IMPROVED PAVER

Among the exhibits in paving equipment at the National Roads Show to be held in Chicago, January 16th to 20th, will be the 1922 model of the Rex Paver, manufactured by the Chain Belt Company. It has attracted considerable attention during the past year because of its enclosed type of transmission. The Chain Belt Company is the first to have made use of this type of transmission, so successful with motor trucks, on paving machines. The enclosed transmission is highly successful on paving mixers.

Another distinctive feature that will attract the attention of highway conractors is the enclosed power operated discharge of the Rex Paver. All gears operate in oil so that the manipulation of the discharge chute is not only very easy but also remarkably fast. The swinging of the chute responds almost instantly to the touch of the lever.

The Paver on exhibition will be equipped with the full length type of traction adapted to the three suspension principle. A new type of Rex Distributing bucket will also be shown.

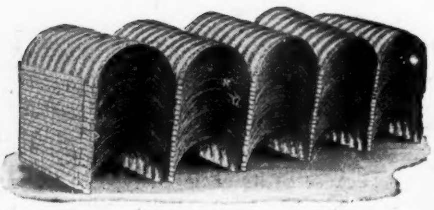
The company also plans to exhibit a central mixing plant mixer with features that are a radical departure from the present mixer standards.

BUTT JOINT NESTABLE CULVERT

This culvert, for which the Floyd & Hubbard Co., Inc., are agents, is manufactured by the Chattanooga Road Machinery Co., and is made of nestable sections of corrugated sheets claimed to be 99.90 per cent. pure iron, and each square foot of exposed surface is coated with two ounces of spelter. Running along both longitudinal edges of the sections, and flush with them are flat bars of iron of the same quality metal as the culvert, which, where they come into contact with the convex points of the corrugations are electrically welded to the latter. When making up a culvert these units are simply placed edge to edge, one on top and one on the bottom and the two halves are held securely together by keys that slip behind the bars on the upper and lower sections.

These sections are of a standard length of approximately 2 feet, consequently a culvert of any desired length can be made up. All units are exactly alike, and there are no special top, bottom or end sections, no male or female joints, so no chance for a mistake in assembling. The galvanized keys are of the same material as the culvert and are die cut, assuring uniformity and absolute fit. The culvert is supplied in sizes from 8 to 96 inches in diameter full round, and also with flat bottoms.

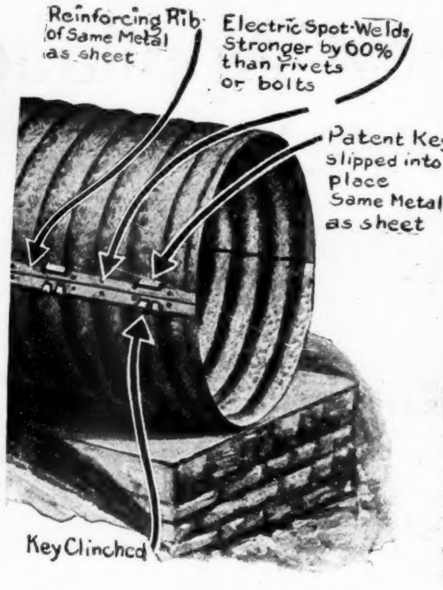
Butt joint nestable culvert is claimed to be 50 per cent. stronger than riveted. The shell forms a perfect circle, with no overlapping longitudinal seams.



SECTIONS NESTED FOR STORAGE OR SHIPMENT

There are no bolts or rivets and no holes anywhere in the metal.

The flexible joint cannot be broken and permits the culvert to conform to the unevenness of the ground. It is perfectly tight, with no wide flange to interfere with tamping, and no bent flange to crack the galvanized surface. It has a double thickness of metal two inches wide every two feet. The culvert can be opened up at any point for cleaning. When nested, it occupies about 1/10 of the space riveted pipe does. Can be unloaded, hauled, assembled and installed by one man. Trucks are not necessary for hauling, the rear of a Ford touring car will hold 100 feet of 12-inch butt-joint nestable culvert.



DETAIL OF ASSEMBLED JOINT

(*Continued from page 36*)

IOWA ENGINEERING SOCIETY

Thirty-fourth annual meeting, Sioux City, Iowa, January 17-18-19-20, 1922. John H. Dunlap, president, Alvin Le Van, vice-president, Lloyd A. Canfield, Secretary, J. D. Wardle and Henry H. Dean, directors.

January 17, Afternoon: First session of the section on Drainage Engineering Assessments of benefits in drainage districts in which are included one or more existing districts: Tile districts, Ben H. Lamb, Spirit Lake, Iowa, County Drainage Engineer; discussion. Open ditch districts, Seth Dean, Glenwood, Civil Engineer; discussion. The differences in the principles to be used in making benefit assessments in flood protection districts and in drainage districts, C. H. Young, Mucatine, Iowa, President, Central States Engineering Co.; discussion.

Evening: •Second session of the section on drainage engineering. Sub-soil of a factor in drainage design, Prof. G. R. B. Elliott, St. Paul, Minn., University Farm; discussion. Recent amendments to the drainage law and recent court decisions of interest to Drainage engineers, Judge John W. Anderson, Sioux City, Iowa; discussion. Aerial photography as used in drainage surveys, J. H. Mayne, Council Bluffs, Iowa; general discussion.

January 18: Address of welcome, T. H. Johnson, Sioux City, Iowa, Consulting Municipal Engineer, President Engineer's Club of Sioux City. President's address, John H. Dunlap, Iowa City, Iowa, Prof. of Hydraulics and Sanitary Eng., State University of Iowa. The business outlook for 1922, H. C. Baldwin, Wellesley Hills, Mass., Member of Babson's Statistical Organization. Afternoon: Simultaneous meetings of all sections.

Drainage Section: The drainage engineer's compensation, Edward B. Tourtellot, Oelwein, Iowa, City Engineer; discussion. Report of committee on standard specifications for drainage construction—three subcommittees: Open ditches, C. Moriarty, Sioux City, Iowa. Tile drainage, J. L. Parsons, Fort Dodge, Iowa, County Engineer. Leeves and pumping plants, H. C. Beckman, Muscatine, Iowa; business meeting.

Highway Section: Design and specifications for 1922 bridge construction, J. H. Ames, Ames, Iowa, Bridge Engineer, Iowa Highway Commission. Testing pavements and pavement materials, R. W. Crum, Ames, Iowa, Engineer of Materials and Tests, Iowa Highway Commission. Daily progress record with various types of equipment on pavement in 1921, H. K. Davis, Ames, Iowa, Chief Inspector, Iowa Highway Commission. Gravel road construction, J. F. Reynolds, Storm Lake, Iowa, District Engineer, Iowa Highway Commisssion. Gravel road maintenance, A. H. Cunningham, Storm Lake, Iowa, County Engineer, Buena Vista County. Election of officers and appointment of committees.

Mechanical Electrical Section: The proper distribution of power costs, Chas. F. Schoonmaker, Cedar Rapids, Iowa, Chief Engineer, Quaker Oats Company; Superheating in steam power plants, R. M. Ostermann, Chicago, Ill., Vice Pres. Superheater Co. The function of the state railroad commisssion in electrical transmission line development in Iowa, A. B. Campbell, Des Moines, Iowa, Electrical Engineer for Iowa Railroad Commission. Election of officers and appointment of committees.

Municipal Section: History of sewage disposal in Iowa, Chas. P. Chase, Clinton, Iowa, President, Iowa Engineering Company. Disposal of municipal refuse, Rolland S. Wallis, Ames, Iowa, Eng. Ext. Dept, Iowa State College. Disposal of packing house waste by the activated sludge process at Mason City, Iowa, Edward Bartow, Iowa City, Iowa, Head of Dept of Chem., State Univ. of Iowa. Round Table Discussion: Size of sewer house connection, minimum sewer grades, newer types of pavements, election of officers and appointment of committees.

Railroad Section: Reminiscences of the early days of railroad building in the State of Iowa, James Carss, Des Moines, Iowa, Concrete Inspector, City of Des Moines. Relation of the engineer to railroad operation, R. J. Smith, Davenport, Iowa. Fireproofing of wooden bridges, Eng. of Way and Structures, U. L. & Ry. Co., E. M. Lewis, Des Moines, Iowa, Eng. of Maintenance of Way, C. G. W. Ry. Organization of officers. Election of officers and appointment of committees.

Structural Architectural Section: Measuring public fire protection, Harry J. Corcoran, Des Moines, Iowa, Chief. Eng. Iowa Insurance Service Bureau. Building code problems, Paul E. Wylie, Des Moines, Iowa. Results of recent investigations in concrete, Duff Abrams, Chicago, Ill., Prof. in Charge of Structural Materials Research Laboratory, Lewis Institute. Organization of permanent section. Election of officers and appointment of committees.

Evening: Fifth annual camp fire. This session will be a joint meeting of the Iowa Engineering Society and the business men of Sioux City. The evening will be devoted to short talks by prominent engineers and business men and special entertainment.

January 19, Morning: Business meeting, regular business and officers' reports. Report of standing committee on legislation. Report of special committee on professional practices. Report of special committee on construction costs.

Afternoon: The financial problem of the railroads, C. D. Cass, Waterloo, Iowa, Gen. Mgr., Waterloo, C. F. & N. Ry. Research at the new hydraulic labora- at the State University, S. M. Woodward, Iowa City, Iowa, Head of Dept. of Hydraulics and Mechanics, State Univ. of Iowa. Report of special committee on standard contracts, services and fees.

Evening: Informal banquet and dance.

January 20: Community development and the engineer, William Holden, Sioux City, Iowa, Gen. Sec., Chamber of Commerce. Inspection trips: Visiting representative industries and the engineering features of the city.

KANSAS ENGINEERING SOCIETY

At the meeting of the Kansas Engineering Society on December 22nd and 23rd, the following officers were elected: president, Lloyd B. Smith; vice-president, P. L. Brockway; secretary-treasurer, J. M. Averill; and directors P. J. Ruckel and H. B. Walker.